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MACKAY.

While Mr. John W. Mackay had reached the good age of seventy-two years, his general vigor and youthfulness of bearing were such as to make the news of his sudden death a very painful surprise to his friends and associates on both sides of the Atlantic. Mr. Mackay was a man who could ill be spared from the administration of great wealth or from the management of the vast properties he had built up, especially in the electrical field, during the past 15 or 20 years. It is true he had able and loyal men on his staff, upon whom, indeed, he leaned heavily, but the decision when made was his, and his share of activity and direction was far larger than the outside public imagines.

In our opinion, the European and American public is deeply indebted to Mr. Mackay for cheaper and better submarine cable service, and in this country the work that he undertook in preserving and building up the Postal Telegraph system has done much to promote and improve the efficiency of land telegraphy. The influence he exerted was wholly for good. There was nothing mean or small about him. The calibre of the men he gathered around him is striking proof of his own estimable qualities of mind and heart; and neither capital, nor labor, nor the great mass of the community, was ever affected otherwise than beneficially by his electrical enterprises of whatever kind. Besides, he had not exhausted his worthy aims, for as U. S. Senator Clark, of Montana, remarks: "His ambition in life was to encircle the earth with his telegraphic cable lines, and there was little doubt that he would have accomplished his purpose had he lived." It is, perhaps, too early to tell what will be the disposition of the Mackay telegraph and cable properties as they now stand, but we shall not be surprised to learn that Mr. Mackay with his usual shrewd forethought had provided for their continuance along the lines he had laid down. In the meantime we can but extend our condolence to the family and our deep sympathy with the corps of talented workers, whom he made his friends, who helped him render the names "Postal" and "Commercial" synonyms for progress, efficiency and good service to the public.

GROUNDING SERVICE WIRES.

At the Cincinnati Convention of the National Electric Light Association an unexpected development was an attack by representatives of several smaller light companies on an underwriters' rule relating to the grounding of service circuits. Had the gentlemen followed closely central station history they would have known that the rule in question originated with the electrical interests, and that it was only after years of persistent effort on the part of its advocates that the underwriters reluctantly adopted the same. While conflicting interests naturally give rise in many cases to antagonistic feeling between underwriters and electric light men, attacks on the former should at least contain a semblance of fairness, which in this instance was not the case. It may be added that American engineers are not alone in favoring the grounding of distributing circuits, this practice for years having been general abroad. As was pointed out in the Cincinnati discussion, ill effects from the practice are chargeable, not to the grounding, but to an inefficient state of the main conducting system. In fact, it can safely be assumed that those who oppose grounding are in charge of lines and transformers that sadly need overhauling; or, to state the case in other words, they are maintaining circuits in a condition that may menace both life and property. Even if the usual reasons given for the desirability of

grounding could be successfully disposed of, its practice would still be justified on the score that it serves as a check on the insulation efficiency of a system as a whole.

INDUCTION MOTORS ON LIGHTING CIRCUITS.

Our report of the N. E. L. A. discussion on the operation of induction motors on lighting circuits, abstracted elsewhere in this issue, throws some light on a much-mooted point, but leaves unsaid much that would have been of great interest and value. The discussion brought out in the most forcible manner the wide variety of opinion as to what constitutes good service and what variations of voltage are permissible. With few exceptions the general opinion seemed to indicate that induction motors frequently stopped and started were a nuisance and rarely failed to give trouble. On its face this is a serious indictment, but its charges lose somewhat of their force when one realizes that the two large companies which reported on the matter had no complaints to make against induction motors, either polyphase or monophase. Any sudden call for heavy circuit on any system whatever is likely to cause trouble with the voltage whether produced by motors or by other apparatus, either for alternating or for direct current. The vital point which determines immunity from serious difficulties is that such a call for current shall not vary the drop beyond the requirements of good regulation. Suppose one has, for instance, a two-wire direct-current circuit feeding 1,000 lights at a maximum drop of 5 volts. Now put a 25-hp motor upon the same circuit and at full load it will of itself produce a drop of 2 or 3 volts, and while starting under load, perhaps double that amount. That such a motor would seriously injure the general regulation admits of no debate. Now the induction motor adds its reactance drop to the ohmic drop just mentioned and may, if improperly installed or handled, call for considerable greater starting current than a direct-current motor of the same output. Hence whenever the latter might cause trouble the former certainly would.

To insure immunity from troubles of regulation under variable load the one condition which must be fulfilled is that the largest current required by the motor shall not increase the total drop on the circuit involved beyond the limits of good regulation. This is a simple enough principle, but in the case of alternating current circuits the drop in the primary and in the transformer is too often forgotten. One cannot load a secondary circuit indefinitely without taking the rest of the system into account, and it is a singular fact that in very few alternating current stations is the total drop and its distribution known with any approximation to accuracy. Installed with due regard to the demand for current, an induction motor need not cause any material difficulty even when running an elevator, but such an installation is most emphatically not a proper subject for guess work. In a few instances of the many brought out in the discussion, the induction motor even in small plants had been so carefully installed as to give no trouble, but we are bound to say that these seemed to be the exceptions. We have no doubt, however, that if direct-current systems were generally in use in small places, almost an equal amount of trouble would have been reported with motors under variable load. It was encouraging to note the satisfactory results now and then reported from the monophase induction motors. Obviously, however, if the starting current is adequately cared for, there is no reason why a monophase motor should not give fairly good results, particularly under load only moderately variable. It may have a power factor slightly worse than that of a polyphase motor, but the main trouble is in starting and not in running. The Continental practice of providing monophase motors with a loose pulley is strongly to be commended, and unless polyphase motors are supplied with adequate starting appliances, the same practice may with benefit be applied to them as well.

A polyphase motor with a proper starting resistance in its secondary circuit need never require a current much, or at all, in excess of its normal full-load current, but without this precaution is very likely to cause excessive drop. If adroitly installed with arrangements for starting at reduced primary voltage, it may still give good results if carefully handled, but must be started with considerable judgment to avoid excessive current during acceleration, and it never can give as great torque per ampere as a motor with a properly proportioned starting resistance. The most ominous feature of the reports on induction motors was the trouble produced in some cases in which the motors were on separate circuits, showing that the starting conditions were so bad as to react unfavorably on the generators. It is pretty clear from this that the polyphase induction motors even at the present time leave something to be desired in their properties at starting. Lack of a starting resistance is probably the commonest cause of such trouble, but it is likely also that the general starting conditions are less carefully watched when separate motor circuits are installed, and bad practice accumulates until even the generators are affected. We are inclined to think that a separate motor circuit in a polyphase motor system is a mistake, although separate transformers for the motors are frequently desirable. It is better to take up the motor installation with a full knowledge of the facts and make the conditions such that trouble will not ensue. Of course, now and then one finds a group of motors operating under conditions so severe that a separate circuit is desirable, as it might be on a direct-current system, but a distinct motor circuit tends to carelessness in installation and sooner or later this gets back to the generating plant There was a fashion, too, a few years since, of putting in generators with bad inherent regulation under a mistaken idea of economy, and little good can be expected of such machines under a motor load. But, as a rule, if one takes good care of the individual motor installations the generators will take care of themselves.

SURGES IN TRANSMISSION CIRCUITS.

Professor Baum's paper on this subject, recently read at the annual meeting of the Pacific Coast Transmission Association and reprinted in this issue, contains some interesting suggestions. On the Pacific Coast ideas of line length are different from those prevailing in the East. Here we look upon a thirty-mile transmission line as being long, by comparison with other lines near the Atlantic. There, a thirty-mile line is evidently regarded as a mere trifle, and a line is not long until its miles are written in three figures. The result is, however, that California is the place for studying surges and oscillations on long-distance transmission circuits in their natural wild state, and that they can only be studied in the East, either in actual miniature or in the laboratory, or on paper.

Professor Baum points out that where a long line is tapped at a number of points en route, as is usually the case in long-distance transmission, the surges that may accompany sudden disturbances on the line are prevented from attaining the intensity they might otherwise develop. Their energy leaks out through the various tapping points and branch circuits. This fact may have a marked influence in safeguarding actual transmission lines under working conditions. Theoretically, of course, short-circuits can be avoided, and switches can be opened and closed gradually through resistance of some kind, but sooner or later a short-circuit on the line will occur,

and the sudden interruption of this short-circuit will develop a series of electric surges, theoretically capable of generating a voltage of some 200 times the interrupted current strength in amperes. If a number of branch connections and branch circuits exist along the line, the surges will expend their energy into these channels without much danger. It might even be worth while installing such branch circuits at intervals, artificially, on a long line when no practical demand for power exists midway between the terminals, as, for example, by connecting transformers of small capacity, with which tests on the secondary pressure might also be available.

It is probable that high-pressure switches will be developed capable of safely opening and closing high-pressure transmission lines. Many engineers do not believe in high-pressure switches, and tie their lines permanently to the high-tension terminals of their transformers. It is always more convenient to manipulate low-pressure switches, and where high-pressure switches can be avoided it is, no doubt, good practice to do so; but cases must occur in which high-pressure switches are needed, and in such cases the long arcs at breaking circuit will doubtless be avoided by suitable construction. No high-pressure transmission system can be regarded as safe until a short-circuit can be made upon it without risk of surges, on the one hand, or of breaking the machinery by excessive mechanical strains, on the other. In other words, automatic circuit-breaking devices must be perfected for high-pressure lines, so as to work as certainly and safely as they now do on low-pressure lines.

The paper suggests that the limiting strength of current that can be transmitted over any one long-distance conductor is about 100 amperes, owing to the large inductive drop, or reactance-factor. This seems very reasonable. But the prospect is not thereby rendered discouraging. One hundred amperes at 50 kilovolts, a working or workable pressure at this date, is 5,000 kilowatts, and that is a comfortable unit of power. Three such wires in a three-phase system, with 50 kilowatts between wires, will carry 8.66 thousand kilowatts, and if more power than this is wanted there should be no difficulty in running extra wires, or even extra pole lines. On the three-phase system, therefore, each conductor may, perhaps, be limited to carrying about 3,000 kilowatts, for the purposes of long-distance transmission. Or, still retaining the 100-ampere-per-wire limitation, we may say that in the three-phase system each wire is limited to carrying 1,000 kilowatts at a pressure to neutral of 10 kilovolts, or a pressure between wires of 17.3 kilovolts, as in a 17,300-volt system. There are comparatively few waterfalls, however, that have many megawatts to spare.

THE HYDRODYNAMIC ANALOGUE OF ELECTRODYNAMIC TRANSMISSION.

We reprint on page 127, Professor Eddy's recent paper before the A. A. A. S. The analogy presented in this paper between a hypothetical hydraulic system and actual electric transmission systems is very useful for presentation to the student, since the mind readily grasps the hydraulic phenomena on account of the sight-memories connected with the action of hydraulic machinery; whereas the electric phenomena are invisible, and produce no direct sight memories. On the other hand, it should be pointed out that, in general, care is required in applying mechanical analogies to electrical or similar phenomena, and above all, the lack of identity should never be lost sight of. Indeed, we very much doubt the value of analogies in science, and particularly in applied science, except to assist the layman who wishes to obtain what to him will answer as an intelligent idea of a phenomenon, or as a first step to assist the student in co-ordinating new ideas. He who wishes to obtain true conceptions must study actual phenomena, and while this course in some cases may require more time than if analogies were availed of, in other cases less time will be required, particularly if the seeker for enlightenment also lacks exact knowledge of the mechanical or other phenomena entering into the analogy. With the increased intellectual competition brought about by increase of technical education, the man who knows things at first hand is at an advantage with respect to one who is contented with knowledge by analogy.

The generator of Professor Eddy's analogy is a double-acting force-pump, delivering an alternating flow of water, through a hose of elastic walls to a distant oscillating motor-pump. The elesticity of the hose corresponds to electrostatic capacity, the inertia of the water to inductance, and the friction to resistance. The elasticity, inertia and friction co-operate hydraulically in essentially the same manner as capacity, inductance, and resistance in an electric transmission line. If the hose is uniformly leaky to a given desired extent, the analogy to the electric case is thereby also maintained. The application of the alternating watermotive force by the driving pump, produces a succession of impulses which travel around the hydraulic circuits in waves that would be visible to the eye by the pulses of the distending and contracting hose. The wave-length of these impulses would be adjustable by adjusting the elasticity of the hose or the density of the liquid. The attenuation of the impulses with time, or with distance from the source, would depend upon the friction, upon the elasticity, the density and the leakage. The formulæ would all be similar to those of the electromagnetic case.

The introduction of the receiving pump or motor, at the distant end of the line, would add new properties to the transmission. A new set of reflected waves or impulses would be set up from the motor. These, mingling with the outgoing impulses, would produce stationary waves. That is to say, while, before the motor was inserted, the waves were all progressive, so that the hose wall at any point alternately rose and fell with the frequency of the force-pump; the insertion of the motor-pump would be capable of producing a set of counter, or reflected waves, whose sum with the initial set would establish constant wave outlines, by which the hose pipe would no longer pulsate, but would distend at some places and contract at others, the distance between successive humps being equal to the stationary wave-length of the hydraulic circuit.

A similar analogy can be traced in the propagation of light through matter, and also in the propagation of waves in oscillating elastic strings. It is possible that the electric case can most readily be apprehended by the study of these material cases. A curious exemplification of the same principles is presented in the circulatory systems of animals. The heart is a cyclically-acting pump, with a frequency of from about one-third to five cycles per second, according to the size of the animal. The flow, however, is pulsating and unidirectional, not alternating. The arterial walls are elastic, and there are present, on the electromagnetic interpretation, capacity, inductance and resistance, without leakage. The inductance is constant, the density of the blood being sensibly invariable. The resistance varies markedly, being controlled in a remarkable manner, according to the needs of the organism, by the calibre adjustment of the arterials. The frequency is also a variable, being adjusted, within certain limits, to the needs of the system. Under these circumstances the arterial impulses, or pulses, have a definite wave-length and velocity of propagation, under given conditions of frequency and resistance. The electrostatic capacity, or arterial elasticity, diminishes with old age, thereby diminishing the transmisson power of the system. It mght be possible, perhaps, to define the degree of senile loss of arterial elasticity in terms of the wave-length, or wave-velocity of circulation, under definite frequency and resistance.

Meeting of the Edison Illuminating Companies.

Mr. Wilson S. Howell, the acting secretary of the Association of Edison Illuminating Companies, has issued the following notice:

The eighteenth annual meeting (23rd convention) of the Association of Edison Illuminating Companies, will be held at the Mount Washington Hotel, White Mountains, N. H., commencing Tuesday, September 9th. A number of valuable papers are in course of preparation on subjects pertaining to the business of the member companies, and already there are indications which point to the coming convention as probably the most valuable of a series of excellent conventions. The Edison Association was organized in 1885 by companies licensed under the Edison patents. It embraces all of the present licenses excepting only a very few.

The Edison conventions are noted for their close application to business, the absence of junketing and the higher beneficial results to its members. The place of meeting this year is selectd because of the absence of outside allurements, with the expectation that this convention will exceed all others in the strict attention to business, for which the conventions of the Edison Association have always been noted.

At the proper time a list of the papers presented and subjects discussed will be given to the technical press.

Following is a list of the officers of the Association: President, Mr. Louis A. Ferguson, Chicago, Ill.; Vice President, Mr. A. W. Field, Columbus, Ohio; Treasurer, Mr. Alex Dow, Detroit, Mich.; Secretary, Walter H. Johnson, Philadelphia, Penn.; Asst. Secretary, Wilson S. Howell, New York, N. Y.

Death of John W. Mackay.

A picturesque and attractive figure is taken from the field of American telegraphy and electrical development by the sudden death of Mr. John W. Mackay. It would appear by the dispatches from London that he was overcome by the extreme heat there last week, causing fatigue and resulting in pneumonia and heart failure. Although 72 years of age, he was vigorous and apparently much younger, attending actively to business affairs, and taking no small share in the development of his latest international enterprise, the Commercial Pacific Cable, for which, indeed, the last contracts were signed in London only a few days ago, just prior to Mr. Mackay's death.

Born in Dublin in 1831, but spending all his life in the United States, Mr. Mackay was fitly regarded as a typical American in every respect. In 1840 his father came to New York, and the boy not only played in City Hall Park, but lived almost on the very spot now occupied by the big building which constitutes the headquarters of the Postal Telegraph-Cable system. In 1851 he found his way to California, became a miner and after many trials and vicissitudes, "struck it rich" in 1865 at the Hale & Norcross mines with Flood and O'Brien. This was soon followed up by the discovery of the Bonanza mines at Virginia City, Nevada, out of which Mr. Mackay once stated that he had taken $150,000,000 in silver bullion. He followed up mining enterprises, married Mrs. Bryant, went into banking, soon became a celebrated international character, and went into a variety of other enterprises.

Several years ago, chiefly through his acquaintance with Stokes, friend and foe of Jay Gould, Mr. Mackay had become financially interested in some of the telegraph companies organized to compete with the Western Union Telegraph system. They went down in wreck, but with the able and brilliant assistance of Mr. A. B. Chandler, Mr. Mackay reclaimed the ruins and in a very few years had built up the Postal Telegraph Company, one of the best and most progressive concerns in the telegraph field this country has ever seen. No expense was spared to give good service, and the absolute confidence of the public was speedily won.

The next and almost inevitable step was the foundation of another submarine cable enterprise to work in co-operation with the Postal land lines. In this plan Mr. Mackay rallied to his aid a formidable ally in Mr. James Gordon Bennett, of the *New York Herald*, and a splendid lieutenant in Mr. George G. Ward. To quote the authoritative statement in that journal on the subject:

"It was through his identification with the Commercial Cable Company that Mr. Mackay's name became familiar as a household word to the people of Europe and America. Twenty years ago the men who then controlled the Western Union Telegraph Company and its appendant transatlantic cables tried to bring into a 'pool' with them all the existing British and French cable lines across the Atlantic, forming an absolute monopoly of telegraphic communication between this country and Europe. With the disappearance of competition the tolls were arbitrarily fixed at a high level and the monopoly held the commercial interests of both continents and the press of Europe and America at its mercy. Protests rose on all sides, but the cable monopoly, confident of its position, was arrogantly indifferent to all appeals. As always happens when competition is abolished, the service deteriorated. Worse still, complaints were soon heard that, with all the messages sent over the Atlantic placed at the disposal of the clique which controlled the pool, there was no longer any assurance of privacy of communication.

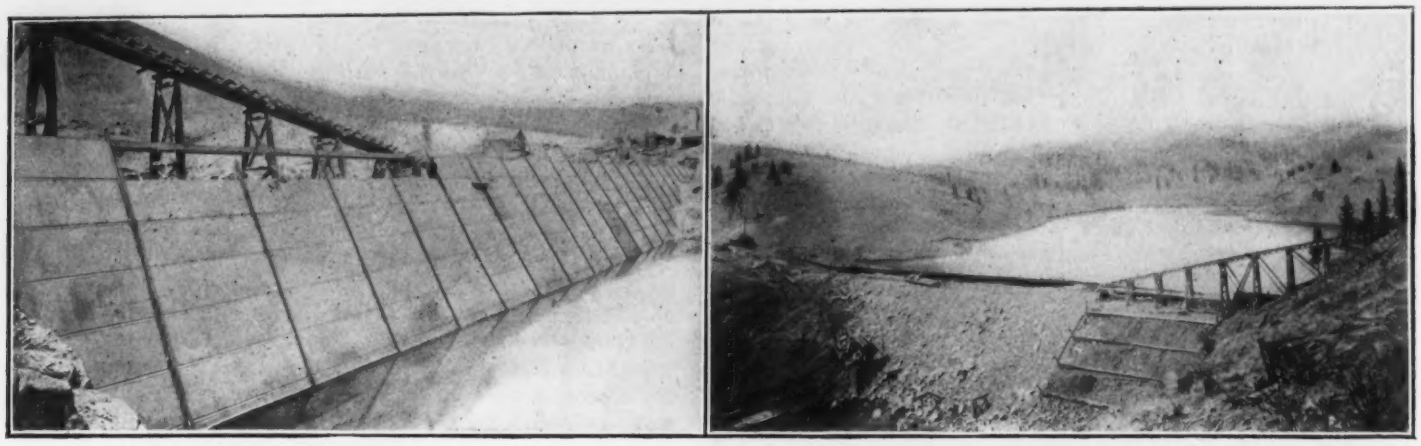
* * * * * * *

"But capitalists seemed to fear incurring the hostility of the powerful financial interests that were concentrated in the pool and held aloof, and it seemed that the *Herald* would alone have to supply the entire capital and lay the cables. Mr. Mackay's clear intellect, however, perceived both the necessity and the feasibility of the work, and with the absolute fearlessness that was one of his characteristics when his enthusiasm was aroused, he joined in the enterprise. It involved a long and hard fight with the monopoly and its agents, in public as well as private life, but the result was the establishment of the Commercial Cable Company (the Mackay-Bennett system), giving the people an invaluable increase in the rapidity of communication between the continents, together with a permanent decrease of nearly one-half in the charges for transatlantic messages. The public-spirited nature of the service thus rendered is not lessened by the fact that, through pluck and skill, aided by the hearty support of the business community on both sides of the Atlantic, the enterprise was made a financial, as well as a moral success. The wonderful development of the Postal Telegraph system of land lines auxiliary to the Commercial Cable Company and the preparations now under way for laying a cable from the Pacific Coast, via Hawaii, to the Philippines, without government aid or subsidy of any nature, alike bear witness to Mr. Mackay's broad views and rare executive ability."

In connection with his telegraph and cable work, Mr. Mackay added two fine new buildings to the architectural features of New York City, the Postal, on Broadway and City Hall Square, and the Commercial Cable, on Broad street, both affording in every respect typical examples of the furthest reach in telegraphic improvements, as well as in electrical equipment. It may be added that Mr. Mackay became interested in Mr. Frank J. Sprague's electric elevator work and did much to push it to commercial success.

Mr. Mackay was a most likeable man, and was loved by all who knew him closely, as well as esteemed by those with whom he came into business and social relationships. For many years Mrs. Mackay had a house in Paris, which was a center for American life in that city; while, since 1891, she has had a mansion in London, where she and Mr. Mackay, whenever he was in England, dispensed a lavish hospitality. Her daughter by Dr. Bryant, was married to and divorced from Prince Colonna, of Italy, and her sister married Count Telfener, a friend of King Humbert. Mr. Mackay had two sons, one of whom, named after him, was thrown from a horse and killed. The other, Clarence, is well-known as a leader in New York society and has been closely associated with his father in the electrical field. There is considerable speculation as to the effect that the death of Mr. Mackay may have on his various interests. His fortune is estimated at different figures, ranging from $50,000,000 up to $100,000,000. A close friend says that Mr. Mackay did not know his actual wealth within $20,000,000.

The Postal and Commercial Cable buildings in New York city and elsewhere have been draped in black, and General Manager W .H. Baker, of the Postal, has sent an expression of the heartfelt grief of all the employes to Mrs. Mackay, who is prostrated by her loss. It is understood that the interment will take place in Greenwood Cemetery, Brooklyn, where Mr. Mackay built a magnificent mausoleum some years ago. Mr. Clarence Mackay is on his way to England, and the directors of the Postal and Commercial Companies are to meet in New York City on Friday to take action regarding his father's death.



FIGS. 1 AND 2.—DAM FOR PIKE'S PEAK POWER TRANSMISSION.

Power Transmission in the Pike's Peak Region.

BY R. M. JONES.

THE Pike's Peak Power Company, whose general offices are at Victor, Colo., was organized in 1899, under the laws of Colorado. The company during that year purchased ranch property, placer claims and reservoir sites on West and East Beaver creeks, in Teller and Fremont counties, and also located, developed and patented placer claims along these streams. At this date it owns all the lands along these streams, including reservoir sites, and all water power privileges, over a distance of 1½ miles on Beaver, 7 miles on West Beaver and 3½ miles on East Beaver. These streams are noted for their excessive difference in elevation in short distances, and produce sufficient water to make of them valuable water power properties. One of the power stations contemplated by the company is completed, and has been in operation during the past year, and known as "Station A," located on West Beaver, in Fremont County, 2½ miles up the stream from the junction of East and West Beaver. The completion of this station has also accomplished much of the development and actual construction necessary for stations "B" and "C," by way of reservoir capacity and pipe line delivery of the water, serviceable to the two lower stations after having been used through "Station A."

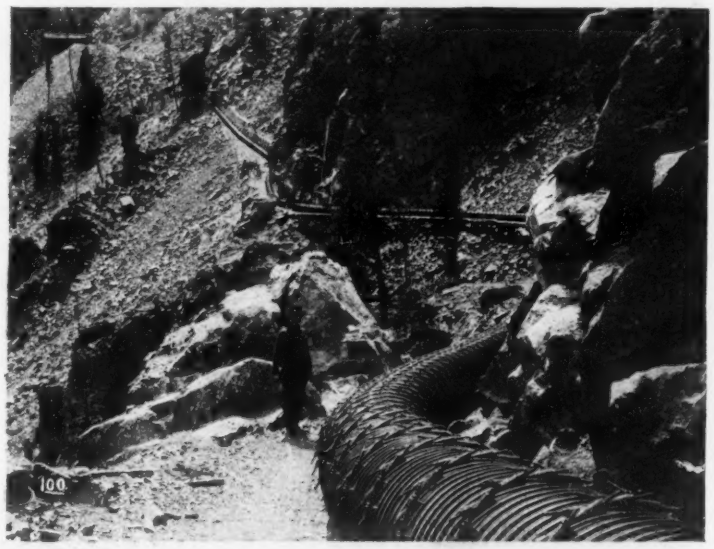


FIG. 3.—A SECTION OF THE STAVE PIPE LINE.

DAM AND RESERVOIR.

The dam and reservoir are located 5½ miles east of Victor. Here is located the largest steel-faced, granite-back filled dam on record to date (Figs. 1 and 2). The structure is in length 405 feet along the cap, 220 feet length of base, 148 feet cross-section of base, and 20 feet cross-section of cap. The upper slope, being the steel face, is 30 degrees from the vertical, and the lower slope 50 degrees vertical. The height of the dam from bed rock to the top of the sixteenth plate (being the spillway) is 70 feet. The spillway is 40 feet wide, cut in granite formation and passes around the northwest end of the dam. The granite back fill, to which the steel plate is laid, is carefully laid in "dry wall" of heavy granite boulders, usually 20 to 80 cubic feet each, as broken by heavy blasting, with loose, fine granite filling the intervening space.

The steel plate is built up of sheets 5 x 15 feet and ½ inch in thickness for the bottom, 8 plates in height. Continuing, the plate is reduced in thickness to ⅜ of an inch, and finally at the cap it is ¼ of an inch. The entire sheet is riveted with horizontal butt straps, and 4 x 5 x ½ inch angle bars are placed vertically the entire height of the dam across each interval of 15 feet for the entire length. The 5-inch leg of each pair of angle bars project into the reservoir and constitutes a standing joint seam, with an iron liner ⅜ x 2 inches riveted between the extreme outer points of these angle bars, thus making a thorough expansion joint for each section of 15 feet. The bottom and end connection of the entire sheet is concreted into a deep channel-way, quarried out of bed rock, and the bottom terminates in two pairs of 5 x 8 inch angle bars, which are

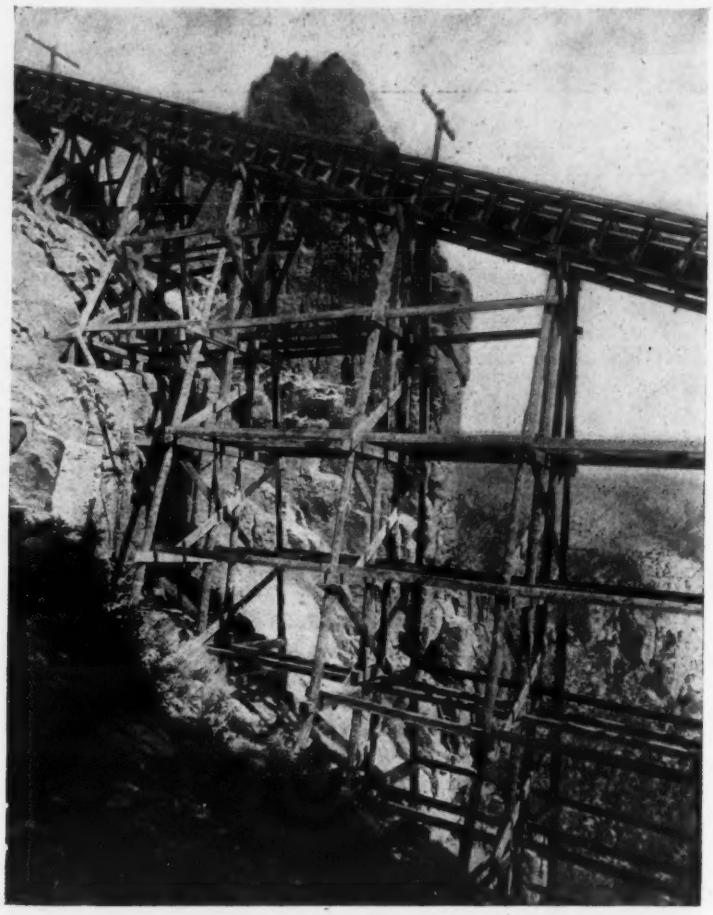


FIG. 4.—FORTY PER CENT. TRESTLE.

riveted through the plates. The end connections are prepared in exactly the same manner, but are applied vertically. The quarrying of the bed-rock channels was carried out horizontally in each case to a point rising to an elevation, and thence the rise was made abruptly in terrace form. The entire sheet is riveted up and calked in the same thorough manner as in boiler practice. A space of six inches was left between the steel plates and smooth surface of the granite back fill. This narrow space is taken up by sand, gravel

FIG. 5.—GENERAL VIEW OF POWER HOUSE AND MOUNTAINS.

and sedimentary deposit, the filling being applied with ample water and permitted to dry before water pressure was allowed to enter. The reservoir has a surface area of 130 acres, and holds 102,000,000 cubic feet of water.

WOOD AND STEEL PIPE LINE.

Water is taken into the wood stave pipe through a "Grizzley" 240 feet long, perforated, giving 30 times greater area than the pipe. The "Grizzley" and the main pipe line are connected to the steel facing of the dam by steel angle connections. The wood pipe is 23,200 feet long, 30 inches inside diameter, and is of 1½-inch redwood stave, banded with ½-inch steel bands and cast-iron lugs. The bands are spaced at intervals along the pipe at all distances between 2¼-inch and 8-inch centers as necessary for resisting the internal pressure; variations being caused by various inverted syphons along the line, two of which reach 215 feet pressure. This pipe line extends over fearfully rough country, about half of the grade being through original granite formation, many curves were on less than 100 feet radius, and one compound curve was 35 feet. The wood pipe passes through the Skaguay Tunnel, which is 1,535 feet in length, located at 21,000 feet from the dam.

From a point 200 feet below the Skaguay Tunnel, where the static pressure reaches 220 feet, the line consists of steel pipe 29 inches in diameter in various thicknesses of plates, ranging from ¼ to ¾ of an inch, as required to meet the internal pressure with an ample factor of safety. The total length of steel pipe, including the receiver, is 2,900 feet, on an incline averaging 38 per cent. It pa es over grades constructed through a granite formation, tougher in respect to roughness than ever was encountered in railroad construction in Colorado. At one point it passes through an inclined tunnel 335 feet in length, just above which is a bridge 70 feet in height, both being on 40 degrees gradient, and at various points there are extremely deep open cuts. From the south end of the Skaguay Tunnel the pipe line is entrenched in the grade on which is constructed a 3-foot gauge railway leading from the Skaguay Tunnel to the power house, its grade being 1,165 feet vertical in 3,100 feet horizontal. This road is the only means of access to the power house. The cars are operated by a double-hoisting engine.

The upper terminus of the railroad lies under a vertical ledge 70 feet in height, and all machinery, apparatus and materials of all kinds were lowered by boom and derrick, taking loads from the wagon at the upper landing and lowering them 70 feet over the ledge to the cars, from which point the loads were lowered by friction brake on the hoist equipped with a ¾-inch steel cable; 1,400 tons of building materials passed down this peculiar railroad. Views of the pipe line, trestle, etc., are given in Figs. 3 and 4.

POWER STATION.

The power house, "Station A" (Figs. 5, 6, 7 and 8) has dimensions 38 x 98 feet, with two side wings 16 x 48 feet each, and is located on the summit of a granite projection surfaced off true to grade. The building is constructed of brick, with steel, corrugated-steel arched roof, concrete, tar and gravel covered; concrete floor, and is absolutely fire-proof. The building is provided with a 10-ton traveling crane. The hydraulic apparatus was manufactured by the Pelton Water Wheel Company, of San Francisco. Each unit consists of two steel disc wheels 66 inches in diameter, keyed to the same shaft, and working in the same wheel house. The base frames are built up in box pattern of the same type and general design as the generators, to which they are connected. The frames of the water wheels and generators are faced for accurate, rigid connection to each other by bolts and dowels. The connection of water wheel and generator shaft is effected by a 7,000-pound steel cast balance wheel, banded with a rolled-tire steel band, 4 inches in thickness. The wheel is 7 feet in diameter, and its hub forms the connection on the water-wheel shaft, and one-half of the hub forms the other half of face coupling keyed to the armature shaft, making an accurate and rigid direct connection of the shafts of the two machines.

The nozzles used with which to produce the required power, as applied under 1,160 feet effective head obtained, require only a diameter of one inch for 236 horse-power, including losses. The nozzles for each unit vary in diameter, one having the capacity of the generator, and the corresponding nozzles for the other wheel in the same unit being somewhat reduced. Each wheel in each unit will produce power for the full capacity of the generator connected. In operation, however, it is customary to install such a varied diameter or capacity of nozzles as to permit the operation of the full capacity of the load demand from time to time by the operation of nozzles under full pressure, and but slight loss in water due to regulation for low loads.

The nozzles are of the deflecting type, and work under full pres-

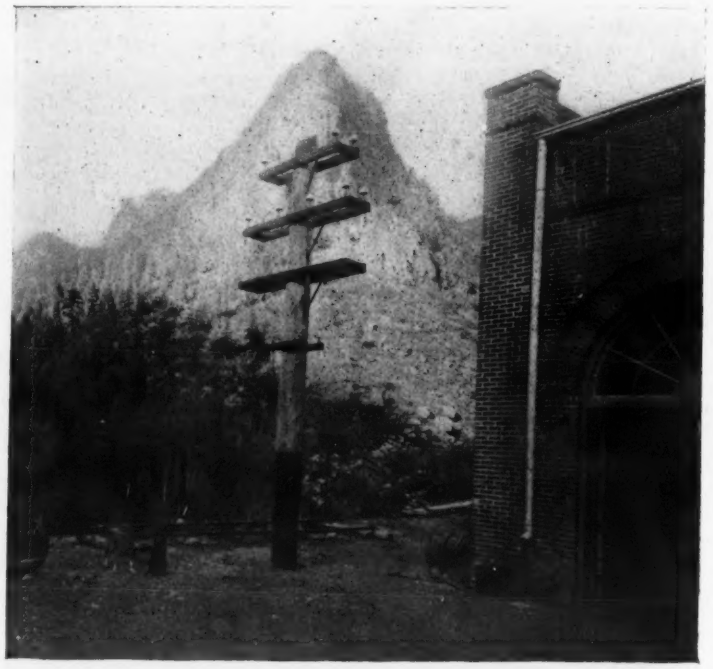


FIG. 6.—MASON'S PEAK AND POWER HOUSE.

sure at all times, which explains the variation in the diameters of the nozzles. The regulation is of the "Armstrong" type, owing to the fact that automatic regulation under existing conditions could be only a failure, without reference to the class applied. Due provision has been taken to extend the actual control and regulation of each unit to a point directly in front of the switchboard panel belonging to that unit. The receiver runs longitudinally through the building under the steel-concrete floor. The discharge or tail-race water returns directly under the receiver to the south or lower end

of the building, at which point it will later unite with water conducted from a point far above "Station A," where a catcher-dam is to be constructed, and the water diverted from the Beaver stream channel. There being a considerable accumulation of water between the dam and "Station A," it is the purpose of the company to unite the waters through "Station A" with the accumulation in the stream, and conduct the combined waters through a pipe line to a point 200 feet above the forks of the east and west Beaver Creek, at which point will be constructed "Station B." There will be built a small pipe line up the east Beaver to the same static level as the tail-race water of "Station A." The waters of both pipe lines will be united before entering the receiver. The pressure of "Station B" will be 1,257 feet, or 544 pounds pressure per square inch. With the added accumulation of water in the west Beaver branch, 3,500 hp will be obtained, and from the east Beaver branch about 2,000 hp, all of which may be developed at "Station B."

ELECTRICAL EQUIPMENT.

The electrical generators now in operation at "Station A" (Figs. 9 and 10) are four 400-kw General Electric machines, three-phase 30 cycles, 600 volts, with stationary armatures and rotary fields, making 450 r. p. m. As already mentioned, the generators are driven directly connected to the water wheels. Two 4-pole exciters, direct-current machines, have a capacity of 30 kw each, running at 675 r. p. m., producing an exciting current at 70 volts each, giving sufficient exciting current for all four generators while working at full load. In reference to the efficiency of the water wheels, it may be stated that they were guaranteed to develop 83 per cent. of power on their shafts at full load when the nozzles are in normal position. In considering the efficiency of the water wheels, the General Electric Company's generators were assumed to have a commercial efficiency of 94 per cent. at full, non-inductive load. Therefore, with every 33,000 foot-pounds of water, the wheels will produce in current one indicated horse-power less 17 per cent. loss in the wheels, and 6 per cent. loss in the generators, delivering 78-100 horse-power, or 582 watts, from the brush-holder terminals of the generators. These efficiencies have been fulfilled by tests. All water connections are tested to 800 pounds pressure to the square inch. In making the efficiency tests, measurements are made through the standard weir commonly used in the United States, verified by spouting tests by working water through the nozzles of known diameters. The developed power is measured by the best electrical instruments obtainable.

The switchboard apparatus (Fig. 11) is especially liberal in design, and is made up of one exciting current panel, four generator panels, two distributing panels, two high-tension panels and one paralleling or synchronizing panel. Each panel is made of Vermont marble, 62 x 36 inches, with a sub-base 28 x 36 inches, and 2 inches in thickness, with a complete equipment of indicating and recording instruments, switches and regulating apparatus. The main line switches from each machine are operated independently either for power or light. The circuits are arranged so that any or all of the machines may be applied on either circuit. The transformers are six 250-kw air blasts, of General Electric make, having 600 volts on the primaries and 12,600 on the secondaries. The 12 complete sets of lightning arresters are of the same make. The cable connections between the generators and switchboard, and from the switchboard to the transformers are all highly insulated, paper, rubber and lead, and laid in conduits in the concrete floor. Since the starting up of this station, it was found necessary to install some thorough system for combined arc and incandescent lighting, which has been fully accomplished by the installation of two 200-kw compensated, three-phase generators, 60 cycles, with their full equipment. These generators are 12-pole, and operate at 600 r. p. m. Each generator contains its own independent D. C. exciter, 12 poles, built directly on the revolving field shaft. These machines are also directly connected to impulse type water wheels.

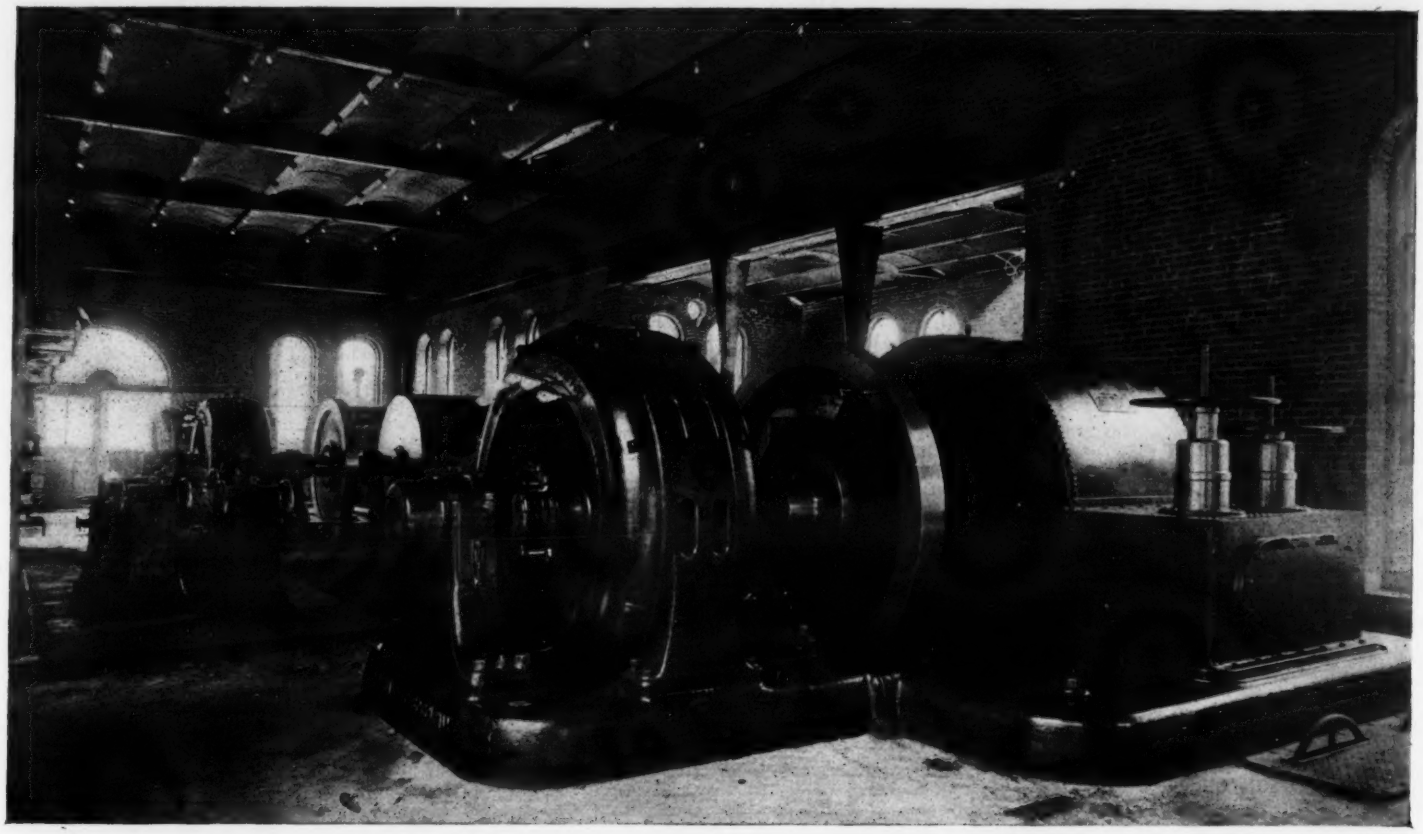


FIG. 9.—INTERIOR VIEW, PIKE'S PEAK POWER HOUSE.

LINE TRANSMISSION.

The line transmission from "Station A" to the center of distribution (at the Gold Coin Mine, at Victor) includes a distance of eight miles by pole line. The circuits consist of three power wires No. 4 B & S. gauge, and the lighting circuits of three No. 6 B. & S. gauge, which are ample to deliver 1,600 kw at less than a five per cent. energy loss. These lines are transposed at intervals of each one-half mile along the line. The poles also carry for telephone purposes two No. 10 galvanized iron weather-proof wires, transposed each 120 feet. The insulators were furnished by R. Thomas & Sons Company, of East Liverpool, Ohio. They are 5½ inches in diameter, of porcelain, and each is made up of three independent cups. In manufacture they were subjected to a 40,000-volt salt test. The line voltage is 12,600, both on 30 and 60 cycle lines.

SUB-STATION AND DISTRIBUTION.

The sub-station is a brick, steel, concrete structure, fire-proof, adjoining the Gold Coin ore house, in Victor. All transmission circuits

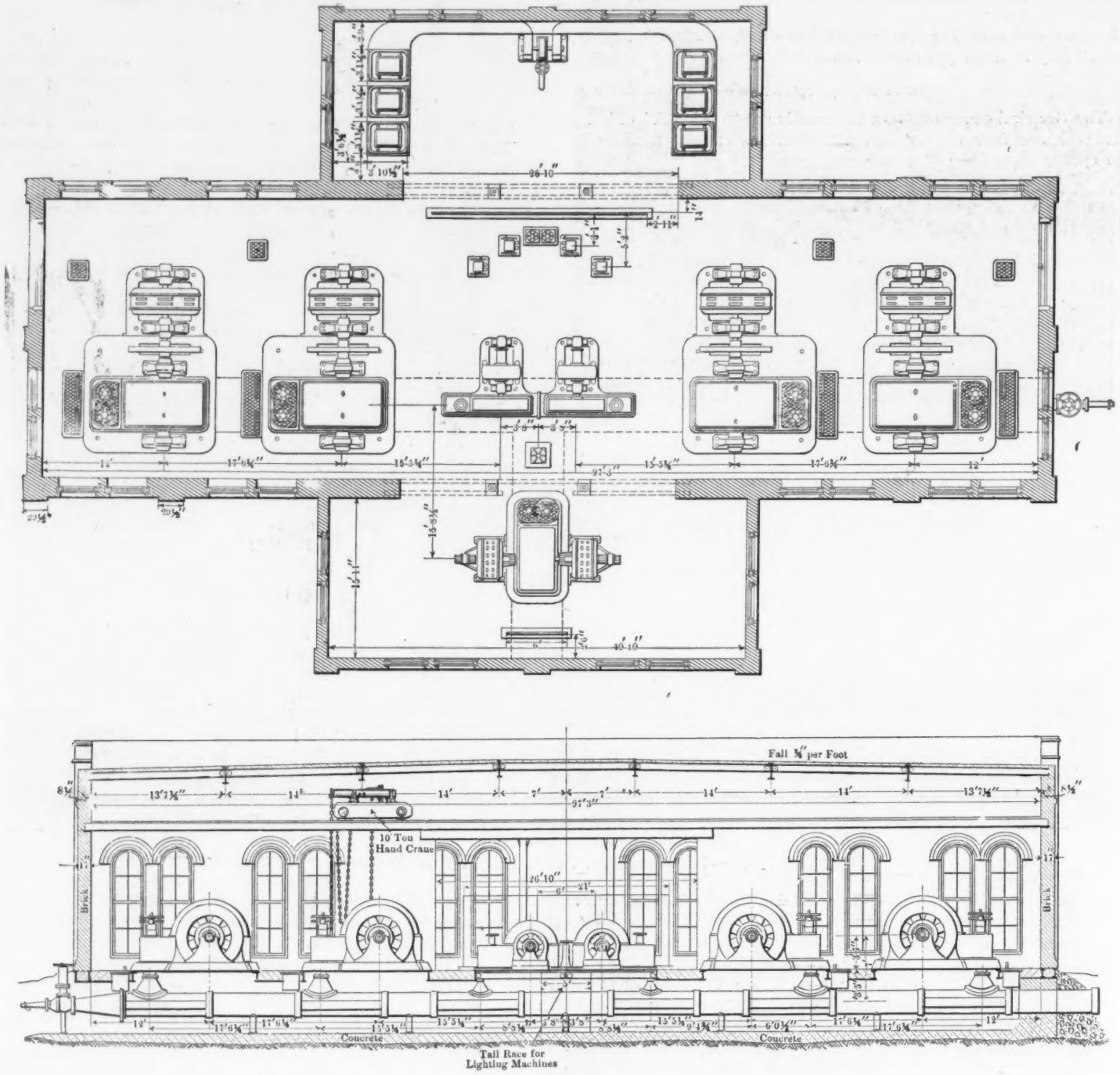
enter this building where the current is transformed through nine 50-kw oil transformers, General Electric type, 12,000 volts primary and 460 volts secondary, for local lighting distribution connected in the Y four-wire system, also, for local power work.

There is installed in addition a set of three 50-kw oil transformers, 12,000 to 350 volts, which operates a 120-kw rotary converter, which drives a locomotive in the United Mines Transportation Tunnel, for ore hauling from first level of the Gold Coin mine to the Economic Mill; and for the Bull Hill Tunnel haulage. High pressure distributing lines leave the sub-station in various directions (after first passing through 20,000-volt oil switches, making each line independent) to Economic Mill, where about 300 horse-power is delivered.

conda and the various mines in that vicinity—the Morning Glory, Doctor Jack-Pot and others. These lines also reach Elkton on the way to Anaconda, where lighting is also distributed. The Pike's Peak Power Company has just begun, in fact, to develop its various points of distribution. It has already reached all the places and properties mentioned with a good, series alternating system of 60 cycle arc lighting, which is distributed in three directions through one 70 and one 50-arc constant-current transformer, located in the Victor sub-station.

PLANS FOR EXTENSIONS.

It is the purpose of the company to construct an independent trans-



FIGS. 7 AND 8.—PLAN AND ELEVATION, PIKE'S PEAK PLANT.

To the Beacon Hill there is a power distribution for hoists, power and lights. To the Deadwood Mine is a line for a 100-hp air compressor, and a secondary 460 volts power circuit reaches Independence, Altman and the Wild Horse districts. Another primary line reaches Cameron and Gillett, after first passing through Goldfield, all for lighting service, and distributed in each of these towns through their local transformers connected in delta.

Two additional primary distributing lines reach Anaconda, where independent lighting and power are distributed to the town of Anamission line from "Station B" to "Station A," and possibly an independent line to the distributing stations in Victor, including the connections through "Station A," thus permitting the use of the entire energy of both stations in parallel over either station's lines, or to work each station independently, as desired. It is also proposed that transmission lines shall be extended from these stations to other localities within reach. Thus, with two complete pipe lines, pole lines and generating station systems, the most unquestioned reliability of service may be counted upon. The distribution of light

and power, together with the company's independent telephone system, constitutes one of the most valuable systems of its kind in the country.

It is also the intention of the company to install a third station on the combined Beaver streams, at a point near the mouth of the cañon, and approximately two miles below "Station B," the lower one known as "Station C." Here the difference in elevation is but 373 feet, but the volume of water will, it is believed, develop 2,100 horse-power less losses.

The company owns also an excellent reservoir site on east Beaver,

FIG. 10.—GENERATORS, SWITCHBOARD AND TRANSFORMERS, PIKE'S PEAK PLANT.

at 1,700 feet elevation above "Station B," and but 2½ miles distant, which reservoir may be developed to excellent advantage in the near future.

PERSONNEL AND INVESTMENT.

It may be added that the Pike's Peak Power Company has a stock issue of $1,000,000 and an authorized bond issue of $150,000, all of which is owned by the Woods Investment Company, of Victor and Colorado Springs. The present cash value of the Power Company

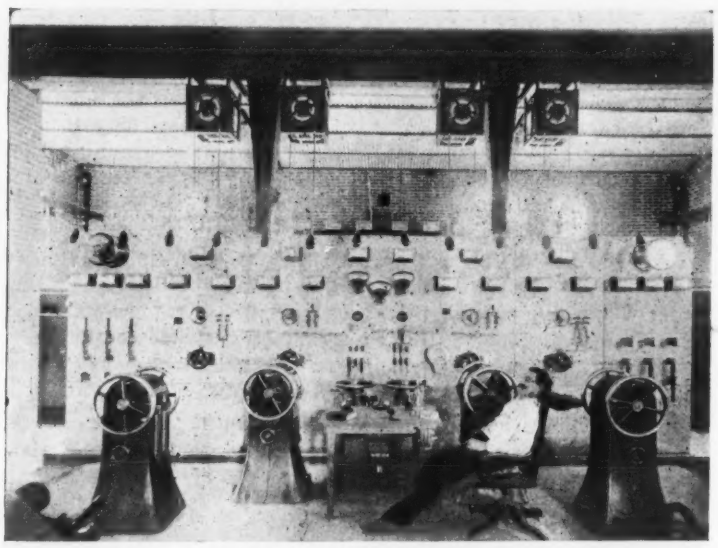


FIG. 11.—VIEW OF SWITCHBOARD AND GOVERNORS.

alone is over $1,000,000. It is represented by Warren Woods, president; H. E. Woods, vice-president; F. M. Woods, secretary and general manager, and R. M. Jones, engineer and general superintendent.

The company was organized and the property developed originally by The Woods Investment Company, for the purpose of supplying power and light to the milling and mining interests owned and controlled by them in the Cripple Creek mining district, but the work of construction was carried out on a basis of much larger magnitude than at first intended; hence the company is now supplying current to other properties and doing a large proportion of the lighting in the various towns in the district.

The engineering in every department of the construction, from the beginning to the present operation, was carried out by R. M. Jones, an old Edison manager, who will be remembered by many as the engineer of The Big Cottonwood Power Company and the "Jordan Narrows" Plant, described in these pages some years ago, both in the Salt Lake Valley, Utah, and prior to this was active in the construction of the central lighting plants and street railways in Wyoming, Montana, Utah and Nevada, beginning with the Laramie Edison Plant, in 1886.

Railroads and Telegraph Business.

Discussing the recent situation, in transferring Pennsylvania Railroad lines from Western Union to Postal Telegraph management, Mr. J. P. Altberger, superintendent of the Western Union in Philadelphia, says:

"The Western Union looks upon the whole affair as a matter of business. It is like the lease of one's house. It is about to expire. Notice has been given to vacate the premises. The Western Union will vacate. That is all. Our pike lines traverse practically the same territory as those on the railroad right of way; and these pike lines, instead of being in a state of decay, as has been reported, are in a far better condition than the railroad lines. We consider, and have always considered them, not only the best from a technical point of view, but also in a commercial way. In most of the towns where the Postal will succeed us in the railroad station we have offices, and will lose little business, and what we do get will be more profitable. The railroad company gets 50 per cent. of the receipts at all these stations. The operator is ticket agent and expressman as well. Naturally, having so much to do, the telegraph business is not given, right along, the best of attention. The message is sent when the operator gets time from his other duties. Besides, there are hundreds of messages for the railroad company sent every day, and these go free, taking the time of the operators at both ends without any profit to the telegraph company. In dollars and cents the Postal will not be better off than they were before they succeeded us. The cost of maintaining these lines quite equals the receipts."

Indiana Electric Light and Power Organization.

In response to a hundred or more invitations about 25 official representatives of the central station electric light and power companies of Indiana held a meeting at the Denison House, Indianapolis, a short time ago and organized the Indiana Electrical Association. Among the chief promoters of the concern are T. A. McReynolds, general manager of the Kokomo Electric Light and Railway Company, and Hal. C. Kimbrough, secretary of the Muncie Electric Light Company. The latter said that the main purpose of the organization was to afford the officers of the various companies an opportunity to become acquainted with each other for mutual information and assistance regarding the transaction of business and acquaint each other with the various methods in vogue. When asked if it was not also the purpose of the association to establish a uniform rate for electricity throughout the state, Mr. McReynolds said that question would be taken up later on. He said that prices throughout the state for light and power range from 5 cents to 20 cents a thousand watts. "After due allowance being made for the varying cost of fuel in different localities adjacent and remote from the coal fields the discrepancy is too great" said he.

The first regular meeting of the association will be held in Indianapolis, September 17 and 18. An interesting and instructive programme will be arranged. It is the purpose of the association to exchange technical information as well as to profit by each other's commercial experience. After adopting articles of association the following officers were elected: T. A. McReynolds, Kokomo, president; J. H. Harding, Laporte, first vice president; R. N. Parrett, Princeton, second vice president; Hal. C. Kimbrough, Muncie, secretary, treasurer; Executive Committee, S. E. Gard, Richmond; C. F. Hewitt, Elkhart; A. M. Barron, Franklin; W. F. Weyerbacker, Booneville. Finance Committee, A. M. Barron, J. H. Harding and C. F. Hewitt.

Surges in Transmission Circuits.*

By F. G. Baum.

A PAPER was presented by Mr. C. P. Steinmetz at the annual meeting of the American Institute of Electrical Engineers a year ago, discussing the subject of the causes and probable effects of the rise in potential over transmission circuits, but the paper was remarkably mathematical, and for that reason probably did not receive the attention it deserved. The subject has since been discussed by Dr. Kennelly[1] and by Mr. Percy H. Thomas.[2] These men are to be congratulated on their clear line of reasoning.

The subject is an interesting one to us, as we have all seen lightning arresters fused on account of the sudden opening of a circuit. I shall attempt to put the matter as briefly as possible, and in such a form that the rise in potential which we may get under the worst conditions may be easily and quickly determined. Three cases will be discussed:

a. Opening a line under a load or short circuit.

b. Closing a high potential line switch to charge the line.

c. Opening a high potential line switch to "deaden" the line.

(*a*) *Opening a Line Under Load or Short Circuit.*—Let us consider the case of a long line with a receiver load concentrated at the end. The line capacity will be assumed equivalent to a single capacity at the center of the line. We will consider one leg of a three-phase system. The self-induction of one wire from the generator to the center of the line, that is, up to the capacity, is L, and the capacity of the entire line as a condenser is C (C is the capacity between one line wire and neutral). A current, I, flows over the line and is suddenly interrupted. As is well known, the energy stored up in the magnetic field (due to the current I), between the generator and the center of line is $LI^2/2$. If the current is suddenly interrupted, this energy must flow into line condenser, since their is no other outlet. (It should be noticed that when the receiver is opened the line condenser is in series with one-half the line and the generator). If V is the resulting potential across the line condenser, the energy stored up in the condenser is $CV^2/2$. But this is the same amount of energy which was previously stored in the magnetic field, neglecting the small loss due to the current flowing over the line resistance in flowing over the line into the condenser. Therefore,

$$\frac{LI^2}{2} = \frac{CV^2}{2}, \text{ or}$$

$$I = V\sqrt{C/L} = VC\left(\frac{1}{\sqrt{LC}}\right) \qquad (1)$$

The current produced in a condenser of capacity C by an electromotive force having a frequency F is equal to (applied e. m. f.) $\times$ $C\,2\pi F$.

Comparing terms with (1) we see that $\frac{1}{\sqrt{LC}} = 2\pi F$,

in which F is the frequency of the current in the condenser. (1) may therefore be written:

$$I = VC\ 2\pi F, \qquad (2)$$

in which F is the natural periodicity of one-half the line. What really happens then when we interrupt the current I, is that the same current, having its natural outlet cut off, flows into the line condenser and charges the line. But the line condenser cannot remain charged, and, therefore, the condenser discharges again into the line self-induction, and the energy again is in the form of magnetic energy. The magnetic field, then, again breaks down, giving up its energy to the capacity and the whole cycle is gone over again and again, until the resistance of the line consumes the energy originally stored in the line self-induction. The frequency of the give-and-take of energy between the capacity and line self-induction is determined by the natural periodicity of the circuit F. The frequency F in the equation (2) is, therefore, the frequency of the current I, after this current has been interrupted at the receiver. If the circuit is working normally at a frequency f, the current I changes from a frequency f to a current of frequency F, that is, from the normal impressed period to the natural period of the circuit.

The natural periodicity of a circuit may be easily found from the equation,

$$2\pi F = 1/\sqrt{LC}, \text{ or}$$

$$F = 1/2\pi\sqrt{LC}. \qquad (3)$$

For a three-phase transmission line we may take the self-induction for one-half line, for one wire, as .08 henries per hundred miles, or $L = .08\,H$, H being the length of line in hundred miles. C may be taken as two microfarads per hundred miles, or $C = 2H/10^6$ farads. Substituting for C and L in equation (3), gives us approximately,

$$F = 400/H. \qquad (4)$$

(This frequency will not differ much for different distances between wires, because an increase in the distance will increase L and decrease C, the product remaining nearly the same. The same is true for different sizes of wire.)

That is, a line 100 miles long has a natural periodicity of about 400; a 200-mile line a periodicity of 200, etc. If we are operating normally at 60 cycles, a 200-mile line has a natural periodicity of little more than three times the frequency of operation.

From (2) we get the potential across the line condenser due to interrupting the current I equal to

$$V = I/C2\pi F. \qquad (5)$$

Substituting for C the value $2\,H/10^6$, and for F the value $400/H$, we get the simple equation,

$$V = 200I \text{ (approximately)}. \qquad (6)$$

That is, the rise in potential is as a first approximation independent of the length of the line and equal to 200 times the interrupted current in amperes. If I is equal to 100 amperes (141 amperes maximum), and the current is interrupted when it has its maximum value, then

$$V = 28{,}200 \text{ volts} = 200 \times 100\sqrt{2}.$$

Interrupting 200 amperes would give us double this rise. This electromotive force will be superimposed on the line electromotive force, so the maximum strain possible for any interrupted current is

$$\text{Maximum strain} = E\sqrt{2} + 200\,I\sqrt{2}.$$

E is the voltage between line wire and neutral, and I is the current in amperes interrupted. It has been frequently noticed that a line having been short-circuited and the short-circuit broken, the short-circuit will frequently re-establish itself or a new short start at some other place between points across which the line voltage could not jump. The superposition of the oscillating electromotive force due to the removal of the short-circuit to the line electromotive force is no doubt the explanation. We have assumed that the current is instantly interrupted. An arc will always be formed which will reduce the rise in potential.

On account of the inductive drop over the line, it is very probable that the current to be transmitted over one wire of a long-distance transmission (100 to 200 miles) must be limited to about 100 amperes, unless the frequency is reduced below 60. One hundred amperes, at 60 cycles, transmitted over a line 200 miles long gives us an inductive drop of about 50 per cent. with 50,000 volts between wires. The generators will probably deliver four times full load current as a maximum on short-circuit. A short-circuit in the center of the line would, therefore, give us about twice full load current, so that the maximum rise in potential due to the interruption of the short-circuit would be about 56,000 volts. If the line is operating at 30,000 volts (equals 30,000 $\sqrt{2}$ maximum) between neutral and line wire, the strain would be a little more than twice the normal. Under certain conditions a greater rise may take place.

In the above we have assumed a long trunk line with a receiver at the end. When the receiver current is interrupted, the line current is forced into the condenser. On our long lines, however, we usually have loads distributed along the entire length, and if there is a load on at different points the line discharges a portion of its energy into the local distributing circuits, and the rise in potential is therefore limited.

The amount of energy stored in one-half of a 100-mile line is quite small. For 200 amperes it is

$$LI^2/2 = \frac{.08\,(200)^2}{2} = 1600 \text{ joules}.$$

That is, 1,600 watts for one second. This amount of energy can

* A paper read at the annual meeting of the Pacific Coast Transmission Association, San Francisco, Cal., June 18, 1902.

[1] "Surges in Transmission Circuits," by A. E. Kennelly, Electrical World and Engineer, Nov. 23, 1901.

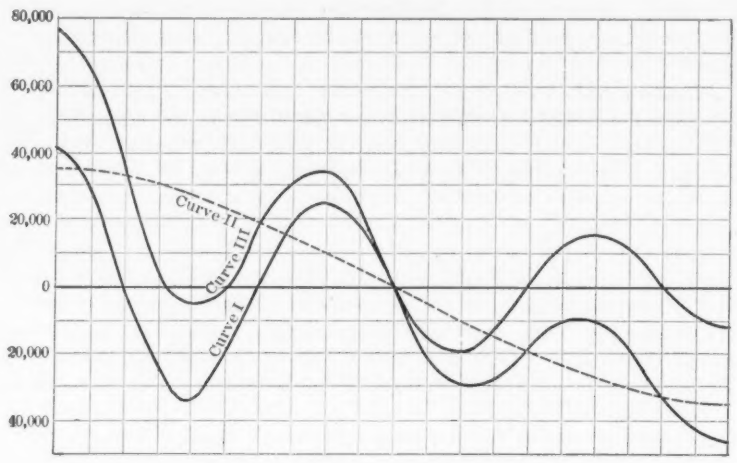
[2] "Static Strains in High Potential Circuits," by Percy H. Thomas, *Transactions* of the American Institute of Electrical Engineers, February, 1902.

be easily consumed by the local distributing systems and the line relieved of excessive strains. It is, therefore, important in a long line to have the loads distributed as much as possible, and then if we have even the worst conditions of a short-circuit no excessive rise in potential will probably take place.

(*b*) *Closing a High Potential Line Switch.*—On first closing a line switch on a dead line, a current will flow into the condenser. But this current to reach the condenser must flow over the line self-induction, and energy will be stored in the magnetic field. This energy will then discharge into the condenser and add to the charge already in it. The maximum rise in potential is double normal working value.

(*c*) *Opening Line Switch.*—If we open a line switch to deaden the line we have the condenser of the line discharging at the periodicity of the line across the switch terminals the moment they are separated, due to the charging current of the condenser, the potential of the line rises to its maximum working value at the normal frequency of the circuit. Before the switch jaws can be separated very far, the line potential due to the oscillating current in the line will be superposed on the potential across the switch due to the generator. This may cause the arc to re-establish itself several times before the line is finally dead. The maximum possible rise in potential in this case is double normal working value.

We see from the above that the most dangerous condition is brought about when we suddenly open a short-circuit. Curve I in



CURVES OF TRANSMISSION CIRCUIT.

the figure shows the oscillating potential due to interrupting 150 amperes on a line about 130 miles long. Curve II shows the generator potential, and curve III the resultant line potential. The voltage of the line is 25,000 between neutral and line wire, and the frequency 60. The current is interrupted so as to produce maximum rise of potential.

The resultant potential, we see, is very much different from the impressed generator pressure. If, we continue to lengthen our lines until the natural periodicity of the circuit becomes nearly equal to the impressed periodicity it is very probable that we will have some new problems to solve. It may be that this will prove the determining factor which will limit the distance of transmission. It is intended to carry on some experimental work in this direction in the near future to determine, if possible, what new problems would have to be met if our lines should reach a length of from 400 to 1,000 miles.

Church Service By Telephone.

Reports from Washington, Ind., state that the Central Union Co. at that place started a new kind of telephone service for the benefit of those who wish to listen to church services going on in the city, without actually attending. Transmitters are placed in front of the pulpit at the leading churches, and subscribers can be connected to hear the church service desired. The first test of the plan was made June 13, when telephone subscribers of Washington and surrounding country listened to the sermon of Rev. J. F. Floyd. The idea is a very old one, but seems never to have been sustained in "commercial" practice by exchanges.

Engine Speeds for Direct-Connected Alternators.

BY EDGAR KNOWLTON.

IN the past two or three years there has been a marked increase in the number of direct-connected alternators, and the angular variation allowable for successful parallel operation has received much attention, the October meeting, last year, of the American Institute of Electrical Engineers being entirely devoted to this subject. This article will discuss the influence of speed on the amount of flywheel effect required.

For ordinary power work, assuming other conditions equal, the flywheel effect varies inversely as the square of the speed, while in engines driving alternators it varies inversely as the fourth power of the speed. The reason for this will now be taken up.

For successful parallel operation it has been found advisable to limit the phase displacement between two alternators to 5 degrees. This means that the revolving part of either machine must not vary from a mean position more than 2.5 electrical degrees. When a conductor passes from the influence of one pole to that of the next like pole, the value of the e. m. f. induced therein passes through a complete cycle of 360 degrees. Therefore, the angular displacement of the revolving part which corresponds to a phase displacement of 2.5 degrees is:

$$\phi = \frac{2.5}{\frac{No.\ poles}{2}} = \frac{5}{No.\ poles}$$

The angular variation is kept within the above limit by the inertia of the revolving parts. Since we are considering only the influence of speed, we will assume that engines of the same type have similar crank-pin efforts, and, therefore, the same relative tendency to speed variation during a revolution.

Let W = weight of the revolving part.
R = the radius of gyration.
S = revolutions per minute.
P = number of poles.
V_0 = average velocity in feet per second at the radius of gyration.
V_1 = maximum, ditto.
V_2 = minimum, ditto.
T = time in seconds elapsing during that speed variation which causes the greatest angular displacement. We will assume that this variation is above the normal.
K = the ratio of T to the time required for 1 revolution.

Then

$$T = \frac{60\,K}{S} \qquad (1)$$

The kinetic energy is given out by the revolving parts changing in speed from V_1 to V_2 is

$$K_e = \frac{W(V_1^2 - V_2^2)}{2g} \qquad (2)$$

$\frac{5}{360\,P} \times 2\pi R$ = number of feet that a point at the radius of gyration becomes displaced from a mean position.

$\frac{V_1 - V_0}{2} \times T$ = ditto.

This assumes a uniform increase of speed from V_0 to V_1, which, while not strictly correct, does not affect the general formula which is here derived.

$$\frac{V_1 - V_0}{2} \times T = \frac{5}{360\,P} \times 2\pi R$$

$$V_1 = V_0 + \frac{.175\,R}{TP}$$

$$V_2 = V_0 - \frac{.175\,R}{TP}$$

substituting the value of T as given in (1)

$$V_1 = V_0 + \frac{.0029\,R \times S}{PK}$$

$$V_2 = V_0 - \frac{.0029\,R \times S}{PK}$$

$$V_1^2 - V_2^2 = \frac{.0116\,R \times S \times V^0}{PK}$$

$$V_0 = \frac{2\pi R \times S}{60} = .1047\,R \times S$$

substituting this value of V_0.

$$V_1^2 - V_2^2 = \frac{.00122\,R^2 \times S^2}{PK}$$

substituting this value of $V_1^2 - V_2^2$ in (2)

$$K_e = \frac{W \times .00122\,R^2 \times S^2}{2g\,PK}$$

For engines of similar type this quantity, K_e, is practically a constant percentage of the foot lbs. of work done during one revolution. Let this percentage equal c, then

$$K_e = \frac{c\,K\,w}{S}, \text{ then}$$

$$\frac{c\,K\,w}{S} = \frac{W \times .00122 \times R^2 \times S^2}{2g\,P\,K} \text{ and}$$

$$W R^2 = \frac{c\,K\,w \times 52800 \times P\,K}{S^2} \qquad (3)$$

$$P = \frac{\sim 120}{S}$$

substituting this value of P in (3),

$$W R^2 = \frac{c\,K\,w \times K \times \sim \times 6{,}336{,}000}{S^4}$$

The variables in the second member of this equation are

$$K\,W, \sim \text{ and } S^4$$

substituting A for the constants

$$W R^2 = \frac{A \times K\,w \times \sim}{S^4} \qquad (4)$$

This shows that the flywheel effect varies directly as the Kw and cycles, and inversely as the fourth power of the revolutions per minute.

In a paper, entitled "Some of the Requisites of Modern Lighting Generator Sets," read by Mr. H. G. Reist before the Engine Builders' Association, and published in the Electrical World and Engineer, of Dec. 15, 1900, there is given this formula for obtaining the weight of the revolving parts of a direct-connected generating set, namely,

$$W = \frac{C \times K\,w \times 100^2 \times 5000^2}{S^2\,(\text{speed in ft. per minute at rad. of gyr.})^2} \qquad (5)$$

The values of C for different cycles and types of engines were given as follows:

	Horizontal Tandem Comp.	*Horizontal Cross Comp.*	*Vertical Cross Comp.*
25 cycles.....	65	40	60
40 cycles.....	104	64	96
60 cycles.....	156	96	144

It will be noticed that for the same type of engine C varies directly as the number of cycles.

Changing the formula (5) to give the value of WR^2, we have

$$W R^2 = \frac{K\,w \times O \times 0^9\,1}{S^4} \qquad (6)$$

This is another form of formula (4).

$O \times 10^9$ being substituted for $A \times V$. When C has the values given above the values of O are as follows:

	Horizontal Tandem Comp.	*Horizontal Cross Comp.*	*Vertical Cross Comp.*
25 cycles.....	410	253	380
40 cycles.....	660	405	607.5
60 cycles.....	990	607.5	910

In addition to preventing too great an angular displacement during one revolution, the flywheel must be heavy enough to prevent too great a variation in speed during the interval between a change in load and the final adjustment of the regulator for that load. The amount of flywheel effect necessary to accomplish the latter bears no relation to the amount required for the former, and it is usually much less; but the author of the paper mentioned has informed the writer that he has occasionally found that formula (5) gives too light a flywheel for the latter requirement when used for the horizontal cross-compound engines driving 25-cycle alternators. It will be noticed that the value of C for such a case is much the lowest of any in the table.

The importance of selecting as high a speed as possible is shown by the following table calculated by formula (6):

Cycles	*K W.*	*S*	*W R²*
60	600	100	3,640,000
60	600	120	1,750,000
60	600	150	720,000

To the advantage of the reduced weight of the revolving part is added that of making the alternator itself smaller and cheaper. With the usual type of generating set having the flywheel separate from the alternator the weight of the flywheel is kept down by using as large a diameter for the wheel as the stresses in the rim will permit. This causes the diameter of the flywheel to be considerably greater than that of the revolving element of the alternator. With a flywheel effect based on the foregoing formulæ the *approximate* weight of the separate flywheel varies inversely as the square of the speed.

Although high-speed is of considerable advantage in sets having a separate flywheel, it is of far greater advantage in the type where the flywheel is combined with the revolving element (usually the field) of the alternator. When this is done it is not advisable to use the same diameter for the flywheel that we would for a flywheel separate from the revolving field. The two principal reasons for this are that the mounting of the poles on the rim would cause additional stresses therein, and the large diameter would increase the cost of the alternator proper, especially the armature frame. For the greater the span the heavier must be the frame to prevent excessive deflection. It is customary to choose a somewhat smaller diameter and increase the section of the flywheel rim to give the required flywheel effect.

A consideration of the formula derived will show that the ideal machine for the flywheel type is one of the lowest number of cycles and the highest speed; and since a high voltage alternator must usually be made of larger diameter than one of low voltage, this might be added as a third requirement. This does not mean that flywheel machines cannot be built advantageously except they meet these requirements, but simply that in comparing the advantages of the flywheel and non-flywheel types, the flywheel type will appear to better advantage when the cycles are low and the speed and voltage high. For instance, the cost of a set of a given frequency, output and speed might be as follows for the different voltages and types:

15,000 volts. Flywheel type, cost represented by 1
15,000 " Separate flywheel, cost represented by 1.25.
480 " Flywheel type, cost represented by .9
480 " Separate flywheel, cost represented by 1.05

The high-voltage flywheel type set cost 20% less than the high-voltage separate-flywheel set, while the low-voltage flywheel set costs but 14% less than the low-voltage separate-flywheel. The question whether the flywheel or separate flywheel type is the most desirable can be decided only after a careful investigation of the costs and the advantages of each. But in either case as high a speed should be chosen as the reliability of operation of the engine will permit. In the Corliss type of engine the speed is usually limited by the valve action. In other types it is usually limited by the heating of the rubbing surfaces and by deterioration of the moving parts, too high a speed necessitating frequent shut-downs for repairs. The tendency is toward higher speeds and engines are now built for speeds that were considered prohibitive a few years ago.

The steam turbine, like the waterwheel, has no tendency to variations in angular velocity, therefore is an ideal engine in this respect. Its high speed makes it possible to secure a large output compared with its size and weight. But more than ordinary care must be exercised in the design of alternators driven by it on account of the centrifugal force of the revolving parts.

Attenuation and Distortion on Long Distance Telephone and Power Transmission Lines Regarded as Hydrodynamic Phenomena.*

BY HENRY T. EDDY.

THE analogy between a steady flow of water in a long pipe under the action of a constant head and a continuous current of electricity under some constant pressure such as is furnished by one or more cells of a battery, has often been employed to give a clear elementary physical conception of the mathematical relations expressed in Ohm's law. In this case the applied pressure is gradually consumed by the resistance experienced by the current, and in strict analogy with the flow of water, the loss per unit of length is proportional to the product of the square of the current and the first power of the resistance. So far as the mathematical relations are concerned the two problems are identical.

It is the object of this paper to extend this hydrodynamic analogy to the more complicated case of long-distance transmission by alternating currents in general.

Telephone transmission has been specifically mentioned in the title in order to include the general case of variable frequency. The importance of thus extending and enlarging this analogy will be evident when we reflect that all the complicated phenomena of long-distance electrical power transmission, by any combination of land lines and cables with their sending and receiving apparatus may be completely reproduced in all its details of operation by simple pumping machinery with its transmission pipes and air chambers, whose pipes and air chambers, whose manner of operation may be made clear to anyone without the aid of higher analysis. Let us first take the case of a double acting pump cylinder and piston in which the two ends of the cylinder are connected by a simple pipe or by-pass without valves. When this apparatus is filled with water and the piston is moved back and forth by a uniformly rotating crank, the water is forced through the by-pass alternately from one end of the cylinder to the other. If the by-pass is short, the resistance to motion may be taken as due to fluid friction only, since the inertia of the water may then be disregarded. This is in every particular analagous in the manner of its operation to a sinusoidal electromotive force acting in a circuit whose induction and capacity may be disregarded in comparison with its ohmic resistance.

But in case the pipe connecting the ends of the pump cylinder be made very long and the size sufficient to greatly reduce the friction, we may disregard this in comparison with the resistance due to the inertia of the water. The resistance due to inertia is proportional to the product of the mass of water moved by its acceleration. Since this acceleration is greatest at the beginning of the stroke and vanishes at middle of the stroke, where it changes to a retardation of amount increasing to the end of the stroke, it is evident that the phase of the current lags a quarter of a revolution or period behind that of the pressure, the pressure being a maximum at the beginning of the stroke, and the current a maximum at the middle of the stroke. During the retardation of the piston the inertia of the water acts to drive the piston forward, and (disregarding friction) as much energy is returned to the piston during retardation as is exerted by it during acceleration, so that on the whole no loss of energy occurs during the stroke. In these particulars this case differs from that previously considered, where the pressure is in phase with the current and energy is expended against resistance during the entire stroke.

Now suppose that fluid friction and inertia coexist in the connecting pipe; it is evident that their coexistence does not affect the separate actions which have been described. The current or flow back and forth is that due to the reciprocating motion of the piston, and the pressure is the resultant of the two pressures already described, differing in phase by quarter of a period. The lag of the current will, therefore, be less than a quarter of a period.

The inertia of the motor is entirely analogous to the self-induction of an electric circuit, and the case of combined fluid friction and inertia is mathematically in every particular the same as an alternating-current circuit having distributed ohmic resistance and self-induction.

Next let us imagine the short by-pass first considered to be sufficiently increased in diameter to make it a globular chamber as large or larger than the cylinder itself, and let it be furnished with an elastic diametrical diaphragm (of sheet rubber for example), which occupies a diametral position whenever the piston is at the middle of the stroke. It is evident that when the piston is at the beginning of the stroke the tension of the stretched diaphragm exerts a negative pressure or suction to force the piston forward in its stroke, which vanishes at the middle of the stroke, after which the pressure exerts a retardation whose amount increases to a maximum at the end of the stroke. But the total energy exerted by the diaphragm and restored to it are equal.

The action of the diaphragm differs from the action of the inertia of the water previously considered in the one particular only; it exerts its greatest forward pressure at the instant the inertia exerts its greatest back pressure, consequently when we disregard fluid friction, the phase of the current is one quarter of a period in advance of the pressure.

It thus appears that the effect of such diaphragm is opposite to that of the inertia of the water, so that a diaphragm having sufficient tension would completely destroy the effect of the inertia of the water. The general effect of this arrangement is to relieve to a greater or less extent the greater pressures, positive or negative, at each end of the stroke arising from the inertia of the water. Furthermore, it may be noticed that a somewhat different device from that just mentioned might be employed, whose resultant action would nevertheless be of the same nature. For example, instead of enlarging the by-pass let two equal air chambers be placed on it, one near each end of the cylinder. This is, in fact, the manner in which relief is actually obtained in pumping machinery, from the shock and greatly increased pressure at the beginning and end of the stroke arising from the inertia of the water. Mathematically, the effect is the same as that of the diaphragm previously described.

The operation of the diaphragm and air chambers just considered is strictly analagous to that of capacity in an alternating-current circuit, the diaphragm to capacity in series, and the two air chambers to capacity in shunt, and by these self-induction may be neutralized to a greater or less extent according to their relative amounts.

We have thus far considered merely the peculiarities of the transmitting or connecting pipes in their relation to the double acting force pump regarded as the source of energy. We need next to consider a receiving pump which shall take and utilize the energy not expended in fluid friction. Let the receiving pump be assumed first to be exactly like the force pump, and to actuate a crank, flywheel and other machinery on which energy is expended uniformly. The crank end of this second cylinder is connected directly by a pipe with the crank end of the force pump, and the other end likewise. In this case the energy expended in fluid friction and inertia may be neglected in comparison with the energy transmitted; this arrangement will transmit power from the driving crank to the driven crank much as would a belt or train of cog wheels. But suppose now that the second cylinder is connected to the first by very long pipes, miles long for example, in which the inertia of the water becomes a controlling factor of the transmission. It would evidently become practicably impossible to make the water oscillate with any rapidity in such a closed pipe under ordinary circumstances. But let there be a series of air chambers uniformly distributed along the entire length of the connecting pipes, or, what would amount to nearly the same thing, let the pipe be an elastic hose requiring equal pressures to enlarge or diminish its cross section.

This will at once entirely change the circumstances of the case, for the air chambers near the force pump will readily receive the water as it flows from the force pump and transmit it to those next along the line and so on, so that a wave of pressure will pass along the pipe and at the same velocity a wave of current will pass having its maximum flow at points where certain high pressure air chambers are discharging into those next along the line. By these progressive pressure and current waves, energy will be transmitted to the working cylinder, which need not in this case be of the same cubic capacity as the force pump. Several complete waves may be in progress of transmission along the pipe at once. The frequency of oscillation in the working cylinder will be equal to that of the force pump to an amount which may be completed in any given case. But it will lag in phase behind that of the force pump to an amount due to the number of waves and fractions thereof in progress of transmission along the line, and to all the inertia of the working piston, etc.

It is evident that when the two cylinders are equal in every respect, except that the piston of the second cylinder is of such large

* Paper read at the Pittsburg meeting of the A. A. A. S.

mass that its inertia is great, and when in addition we may disregard fluid friction, and the flywheel of the second cylinder is running idle, that no work is expended in the system. In this case the second piston will originate transmission waves precisely as does the first, but in opposite direction. The resultant of these equal and opposite progressive waves will be a system of stationary waves along the line. Whenever the amount of energy used at the working cylinder is small compared with the total energy, kinetic and potential, at and near the receiving apparatus, the waves originating there will approach the magnitude of those received by it. Any discontinuity of mass in the current flowing pipe, as for example mercury in place of water for some bent of the length pipe, will originate reflected or return waves. To insure good transmission, little or no discontinuity in the distribution of the inertia along the pipe should occur at any point of such as would be due to changes of size or otherwise.

All these results are equally true of alternating-current circuits.

It may be shown from elementary considerations that the progressive velocity of the waves in the transmission pipe under consideration is constant for all frequencies of oscillation in case of a pipe in which the friction may be disregarded, but that the velocity increases as the square root of the frequency in any case where the inertia of the current may be disregarded. The case of unequal velocity of the waves propogating the harmonic components of sounds in telephone transmission by reason of their difference of pitch, which is one cause of the distortion of sound in long-distance telephone transmission, has been treated at length in the researches of Dr. Pupin, who has investigated very fully the inductive (or inertia) loading necessary in order to render lines practically distortionless. It is equally a hydrodynamic phenomena. The one question remaining for elucidation is that of the attenuation or gradual diminution of amplitude of waves as they progress along the line.

It may be readily shown that in both of the two extreme cases already considered, namely, those in which either friction or inertia is disregarded, that the logarithm of the reciprocal of the amplitude, or intensity of the wave at any point, varies directly as the product of the distance of the point from the source of the wave by its velocity. Since this velocity has already been shown to be constant in case the fluid friction may be disregarded, and to increase with frequency in case inertia is disregarded, it is evident that attenuation depends upon frequency in case of fluid friction without inertia, but is independent of frequency in case of inertia without fiuid friction. Such unequal attenuation in the telephone obliterates to a greater or less extent tones of high pitch before it does those of lower pitch. It is, therefore, necessary to distinct transmission that the self-induction of the line should be large enough to store a large amount of kinetic and potential energy in the wave motion along the line, which in all its aspects is strictly analagous to the wave motion propagated in the water in the apparatus just described.

Induction Motors.

The "Question Box" at the recent Electric Light Convention contained several queries relating to the operation of induction motors and these brought out a large number of replies which form a valuable contribution to the practical side of the subject. Below we give the various replies as offered in written communications or in discussion of the questions at the meeting.

In reply to the question: Is it possible to operate induction motors for elevator service and other intermittent use from lighting feeders without serious disturbance to electromotive force? Mr. Ralph D. Mershon said such induction motors can be used for elevators and other intermittent services, and if the proper type be installed will cause practially no more disturbance on the lighting feeders than would be caused by the corresponding direct-current shunt motor for the same service. Mr. W. T. Oviatt said his experience was that it is not possible to operate induction motors for intermittent service from lighting feeders without interference with the lighting. His experience includes single phase up to 7½ hp, three-phase up to 15 hp. The single-phase motors have been operated from a large system of secondary mains and separate transformers; the three-phase have been operated only from separate transformers, and in all cases it has been found that they produce a serious disturbance to the lighting. Mr. F. L. Sargent, of Malden, Mass., said that the motor business of his company is all three-phase and it does not allow any elevator service on the three-phase motors unless the motor is running continuously on tight and loose pulley, or in a case of a hydraulic elevator with a by-pass valve, as otherwise too much disturbance is caused in the e.m.f. on the generators. He added that all of the power service is on circuits independent of lighting circuits. The experience at El Paso, Tex., of Mr. J. E. Barker with induction motors for elevators has been that the frequent starting and stopping causes the line e. m. f. to fluctuate to such an extent that it is impossible to do a satisfactory lighting business from the same line. This is not so important if a special power circuit is run, but, as the starting current is often four times the full-load current, it is evident that large generators would be required to take care of a relatively small amount of business.

Mr. H. B. Geer, of the Chicago Edison Company, expressed the opinion that induction motors may be operated for elevator service and other intermittent uses from lighting feeders without serious disturbance of the pressure, under certain conditions. In Chicago this class of service is being carried on four-wire three-phase circuits operated at 2200 volts from neutral to phase wire, with 3800 volts between phase wires. The circuits carrying these motors carry the lighting load on one phase, the size of the wire on that phase and the neutral being designed to give 5 per cent. drop from the station to the distributing center. The other two-phase wires are No. 6 uniformly, the lighting wires being mostly No. 2. Such a circuit will carry elevators operated by 10 or 15 horse-power motors without serious disturbance in the pressure at a distance of two to three miles from the station or substation. Mr. J. H. Perkins, of Youngstown, O., considered that under certain relative conditions between generator and motors, and if the motor is supplied by an independent transformer or a bank of transformers whose capacity is large relative to the motor, it is possible to operate satisfactorily induction motors on elevator loads. Mr. Charles F. Scott said the answer to the question depends on conditions. In some stations where the conditions are favorable various classes of motors can be operated without interference to the lighting service. In other cases it is not true. The same statement might be made with regard to direct-current motors. The question might be put: Is is possible to operate direct-current motors for elevator service and lighting on the same service? I know of cases where the induction motor has been criticised for not doing good work on elevators where a direct current motor would not be used, and in such cases the induction motor is expected to do more than the direct-current motor would do.

Another question considered was as follows: What specification should prevail in purchasing induction motors to insure least disturbance to line electromotive force?

In reply Mr. Ralph D. Mershon said that the type of motor should be that having a rheostat included in its secondary circuit, the rheostat being such that it may be cut out by as great a number of steps as is necessary to keep the disturbance down to the point desired. In specifying the number of steps there shall be in the rheostat and the magnitude of each step, one should follow the course which would be followed in specifying the starting rheostat for a direct-current shunt motor for the same service as that which the induction motor has to meet. In addition, the motor should, of course, have as high a power factor at all loads, as is consistent with the maximum torque that will be required of it. Mr. Chas. F. Scott stated that specifications are sometimes presented which place the starting current as a certain fraction of the full load current, independent of the size of the motor. That is evidently not a fair thing, as a circuit which will enable a 10-hp motor to start with, say, its normal full load conditions—that is, taking its normal full load current at the start—would permit of a 1-hp or 2-hp motor being started with 2, or 3, or 4 times its full load current, and not make the same disturbance on the circuit that the 10-hp motor would starting with only its normal current. It would be better, therefore, in specifications of this kind, to place some limit upon the amount of current which can be taken from the circuit, or make different specifications for different sizes of motors instead of making a specification which refers alike to all motors. If the starting current is specified in terms of a full load current, then it may be that a poor motor would pass the specifications, and a good motor would not. For example, suppose two motors were used which took the same starting current, but one of them took a considerably greater running current than the other; the one with the greater running current would then be the poorer

motor, but as it takes less starting current it might pass the specifications where the other motor would not.

Another question, and one which elicited a large number of replies, was as follows: What has been the experience from the use of single-phase induction motors above one-horse power on lighting feeders?

Mr. Ralph T. Patterson, of Waterville, Me., said that his company has in use one 40-hp and one 15-hp and one 25-hp induction motors on its lighting service lines, with no bad results, although it is true that there is a variation of the voltage in starting and stopping them. Mr. F. L. Sargent, of Malden, Mass., said that before the power circuits of his company were completed, several single-phase motors were on our lighting feeders, from one and a half to five horse power, and they caused us no trouble. Mr. W. J. Greene, of Cedar Rapids, Ia., said that a 15-hp, single-phase induction motor caused no disturbance in regulation; at least no complaints were received that could be attributed to it. The motor was in use for five months prior to December 24th, 1901, for operating a stone-crusher. Mr. C. E. Burrows, of Walla Walla, Wash., said his company has a 15-hp Wagner single-phase induction motor running a pump, current being generated at a water-power station five miles away. Every time the motor is started or stopped every incandescent light in town is affected. It is a great nuisance. Mr. H. T. Gille of St. Paul, Minn., said that the largest induction motor on the St. Croix lighting feeders is three horse-power. No trouble has been experienced from motors up to this size interfering with the regulation on the lighting system.

Motors up to sizes of 20-horse-power, Mr. J. H. Perkins, of Youngstown, O., said, had been satisfactory in every way and they will do all that can be done with a polyphase motor. They have an advantage in requiring only two wires and one transformer, which makes the cost of installation less and makes it economical to reach out-of-the-way places as well as the point near the center of distribution. Motors that have been in service some three years have never had repairs or caused trouble. Mr. Perkins added that he would rather have ten alternating current motors on his line than one direct-current. His company operates 500-volt direct-current and both single and polyphase motors.

The Missouri Edison Electric Company reported that the entire alternating-current distribution of the company is single-phase. In the concentrated business district it has the transformer secondaries cribbed on a three-wire system, this network being fed from large transformers, the primary circuits of which are independently controlled from the station distribution switchboard. This network is of ample capacity for almost any demand that may be made upon it, and throughout this district it has been our practice to place no limit upon the sizes of single-phase alternating-current motors installed. Several hundred single-phase motors are operating with entire success on this underground network, a number of which installations have individual units as high as 35 horse-power, with individual customers taking as high as 75 to 100 horse power for motor service alone. Practically all of these motors are of the Wagner Company's type, wound for 208 volts. In starting they are thrown on 104 volts, on which pressure they run up to about two-thirds speed, and are then thrown over to the 208-volt feeders. No difficulty has been experienced in operating incandescent lamps on the same service feeders, and the use of single-phase motors in preference to other methods has enabled the company to very greatly simplify its general distribution system.

In the outlying districts of St. Louis, the alternating feeders are of 100 kilowatts capacity each. On these circuits the installation of single phase motors is permitted under the company's supervision, up to 10 and 15 horse power. In one particular instance a 15 horse power motor is operating satisfactorily at a distance of four miles from the station. It is the practice to require all these motors to be wound for 208 volts, and it is exacted that they start on 104 volts in exactly the same way as in the downtown districts. Where the motors are located at remote distances from the station, it is also recommended that they be started without load. By careful supervision of these outlying installations, the company has been able to take on a great deal of alternating current motor service without detriment to its lighting distribution, and in its opinion the single-phase motor of to-day is a thoroughly practical and satisfactory machine; and if installed with intelligent supervision, it affords a means of securing a very satisfactory alternating day load, from districts into which it would be expensive and inconvenient to carry either polyphase alternating or direct-current system of distribution.

The Quincy Gas & Electric Company reported that it has a number of these motors installed. By putting in sufficient transformer capacity, as recommended by the companies furnishing the motors, no difficulty or inconvenience is found in running them on lighting feeders, and their use beyond the regular power circuit is quite a help to the income account. Mr. H. B. Gear, of the Chicago Edison Company, said that single-phase motors of one to five horse power are being operated for general power work in large numbers in Chicago from lighting feeders. Such motors when started will often produce a dip of about five per cent. in the primary pressure; but as they are started usually not more than two or three times a day and at times when very little lighting is in use, there has been no difficulty with customers' complaints on account of these motors being on the same circuit. Motors of one-hp or larger are carried on separate transformers. In a few instances, installations of several two horse-power motors aggregate 10 to 12 horse-power. These motors have been found to affect the shape of the day load curve very noticeably. The Whitehall (Ill.) Electric Company reported that in the last three years it has installed seven of this type of motors and is very well satisfied with the results. It has two of 25 hp, three of 10 hp, and two of 2 hp. The two 25-hp motors have particularly hard service; one is used to pump water from the city reservoir to a tank, being run after midnight, without attendance, and lifting 15,000 gallons 150 feet high through 6,000 feet of six-inch pipe. The other is used to run a clay grinder in a pottery, and has to contend with a variation of from no load to 30 hp every half hour, and also a change of 6 hp in the load five times every two minutes. These motors are all run from a 60-kilowatt dynamo, and with one exception are all on the lighting feeders. The company has never had any trouble with the motors, and no complaints from its customers regarding the light furnished. The motors are in first-class condition and there is no reason why they will not continue to give good service for years.

In reply to questions, Mr. B. A. Behrend said that any polyphase motor gives its output with less material than the single-phase motor. You may consider a single-phase motor as a three-phase motor, one phase of which is cut out or interrupted. As to cost, there is a difference between cost and price. You have to compare shop cost and selling price on two entirely different bases. You may have to sell a three-phase motor for about two-thirds of what you would have to sell a single-phase motor. It is perfectly natural that a single-phase motor should cost more than a two-phase motor, because it contains more material. Mr. C. C. Badeau, of St. Louis, said that Wagner single-phase motors sell for less than two-phase motors. President Doherty added that the selling price is what the traffic will bear, and not what the apparatus actually cost. This is not always the case, but it is sometimes true.

Mr. Frank H. Taylor of Pittsburg, said that the experience of central station people with alternating current motors is about the experience that he used to have as a salesman for Yale locks. There was no apparent reason why Yale locks should cost more than Corbin locks or the locks of any good manufacturer; but anyone who bought a Yale lock was never sorry he bought it and paid the price which it cost. The same thing is true of induction motors. The price is not excessive and anyone who buys one motor will buy more.

In reply to a query, "What system of charging best lends itself to the supply of power with induction motors?" Mr. W. J. Greene, of Cedar Rapids, Ia., favored a two-rate system, in which allowance is made for the cost of increased investment in generator, transformer and wire capacity, due to the effect of the low power factor. Another opinion expressed was that a consumer should be charged for "readiness to serve," on basis of maximum demand of motor. The maximum demand should, in this case, be considered the demand which would blow a fuse of rated capacity, as distinguished from instantaneous demand.

Traction in London.

A cable dispatch says: The bills affecting the Morgan and Yerkes underground railroads in London have been passed to a second reading by the House of Commons. The House of Commons has passed the bill authorizing J. P. Morgan's London United Electric Railways. Mr. Yerkes opposed the bill.

New Telephone Patents.

The issue of the Patent Office for July 15 contains three telephone patents, one relating to a hook-switch and two to silence booths. A patent on a hook-switch (which part of a telephone set, by the way, is generally called a switch-hook) requiring no fewer than twenty-one claims to cover its varied details, will strike many telephone men as coming rather late in the day, but such is the progress of invention! The inventor, Mr. William W. Dean, of Chicago, claims that his method of mounting the switch-hook springs and contacts is more reliable than other methods, not subject to failure through warping or swelling of the woodwork, nor to bad contacts through including the hook itself or the spring in the circuit.

In the Dean device the hook is pivoted on a metal bracket which also carries the spring controlling the hook and the contact springs; these are insulated from each other and from the bracket, and are controlled by the movement of the hook by means of one of the springs having its free end projecting into a slotted lug on the hook. One of the accompanying figures shows the complete device, above which is illustrated a different form, in which the spring is mounted separately. It will be seen that the hook, spring and contact springs are all carried on the bracket 3. One of the contact springs, 17, projects into the slotted lug, 16, on the hook, so that when the hook rises contact is broken with the lower spring or springs, and the upper springs are forced together. A valuable feature of the invention is that the number of contact springs may be varied as desired to suit any circuit combination by merely adding or taking away springs either above or below the main operating spring, 17, no other change in the apparatus being required.

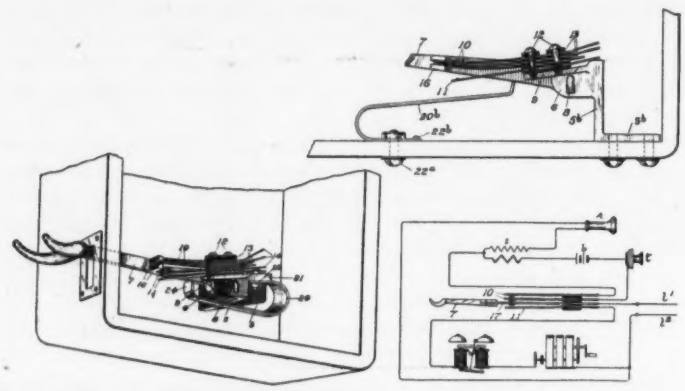


FIG. 1.—DEAN SWITCH HOOK.

A silence booth, built with regard to acoustic principles, is something of a novelty. Mr. Frank Leo Tufts takes out two patents on booths, Figs. 2 and 3, to protect his discovery that booths of circular or polygonal section do not transmit sound from one booth to another as readily as booths of rectangular shape. Mr. Tufts says that where several booths are placed in close connection "it has, heretofore, been found practically impossible so to construct the booths as to prevent conversation in one booth being heard in adjoining booths. To obviate this difficulty, great expense has been incurred in deadening walls and in making peculiarly constructed walls; but the effort has been unsuccessful, chiefly for the reason that sound travels in waves and flat surfaces have a sounding-board effect, so that the sound waves are transmitted from booth to booth. I have discovered that the difficulty may be overcome in a very simple manner—to wit, by making the booths curved, and preferably cylindrical. By making the booths cylindrical or with curved walls the sound waves are not only more or less deflected, but it will be observed that such a booth is braced in all directions, and instead of one wall having the sounding-board effect and vibrating to the action of the sound waves the whole structure must respond, and this being braced in all directions is not likely to occur, so that a series of booths constructed in accordance with my invention, even though comparatively thin and cheap, have the quality of preventing the transmission of sound through the walls thereof." Fig. 2 fully illustrates Mr. Tuft's idea, and needs no description. The drawings show booths with flat tops, but to get the best possible effect the tops of the several booths should be made semi-spherical or dome-shaped, thus preventing any flat surfaces at any point within the booths.

In his second patent, Fig. 3, filed at a later date, Mr. Tufts says that he has been experimenting with sound transmission and finds "that a tube which is circular in cross-section will transmit high notes as well as, and perhaps better than, a tube which is flat-sided; but,

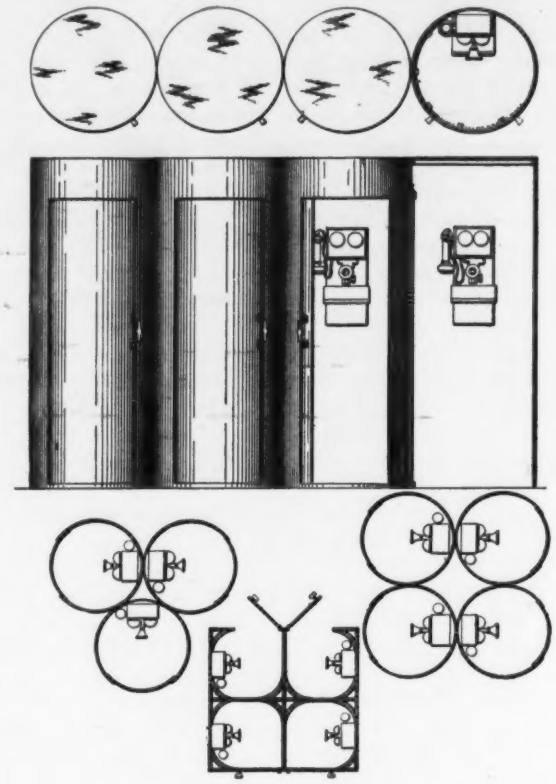


FIG. 2.—TUFTS TELEPHONE BOOTH.

on the other hand, the low notes are cut out by the circular tube, and the flat-sided tube carries them much better. In making these experiments I have found, too, that certain tones, and, perhaps, most tones, can be kept within a booth if it is made octagonal or

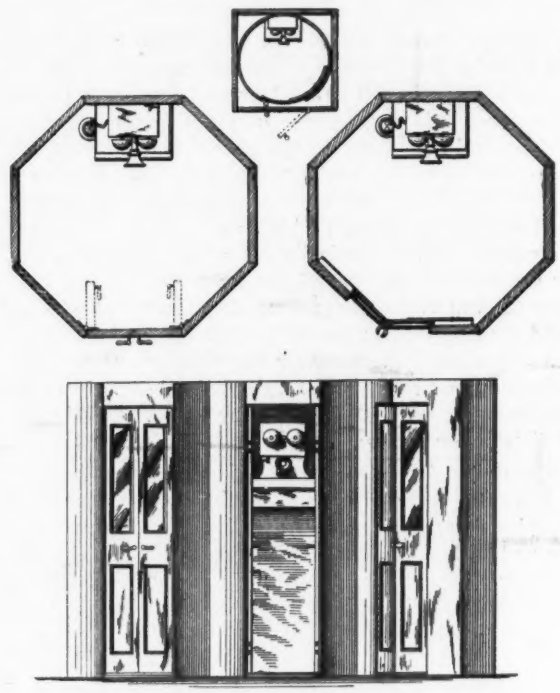


FIG. 3.—TUFTS TELEPHONE BOOTH.

polygonal in shape, or, in fact, if its broad sides are broken so as to be less than the sides of a rectangular booth in width. In carrying out this idea the walls are so braced in different directions as to prevent the vibratory and sounding-board effect. Further, as the circular form of booth cuts out certain tones and the flat-sided booth cuts out certain other tones, I have found that by combining

these two ideas and inclosing a circular booth within a structure having flat sides (even a rectangular outer structure will do), all tones are practically confined to the booth, and so the person using the telephone is in no danger of being overheard from without."

Mr. Tufts says that the octagonal form, as illustrated, is well suited for the intended purpose; but the effect is preserved if six sides are used, and obviously a greater or less number of sides can be made; but the structure must be polygonal or else the sounding-board effect is not overcome and the sound waves go through the walls. To preserve the greatest privacy, a booth of circular cross-section can be enclosed in one of a rectangular or polygonal form, as shown in one of the drawings.

To carry Mr. Tufts' theory to its extreme limit, the "silentest" booth would probably be achieved by making a circular inner booth of corrugated material, enclosed in a polygonal outer shell of which each side should be corrugated, or preferably formed of a series of pieces joined together at right angles. Such a construction would surely destroy all "sounding-board effect." The suggestion is advanced in the pure interest of the science of telephone-booth construction, without hope of future reward.

The Canadian and Niagara Falls Power Houses in Parallel.

BY ARTHUR B. WEEKS.

IT is a fact not generally known that the Canadian Niagara Falls Power Company and the Niagara Falls Power Company have power lines that operate in parallel. This, however, has been the case for many months. The first line to connect the power houses leaves the bus-bars through a feeder switch to the transformers and panels, thence through subways and conduit, and part of the way overhead, to the Canadian power house. Fig. 1 shows the transformers and panel at the Niagara Falls power house.

The current is changed from two-phase to three-phase, no change in voltage being effected. The switches are single element, operated by a pole having a hook which engages in the eye of the switch blade. Circuit-breakers, one on each side on the four-wire side and separated by a marble barrier, effectually rupture the most severe arc. Round carbons, about 1¼ inch diameter, receive the arc upon opening, seldom burning the copper contacts. An ammeter is used on each wire of the three-phase system. Lamps upon the top of the

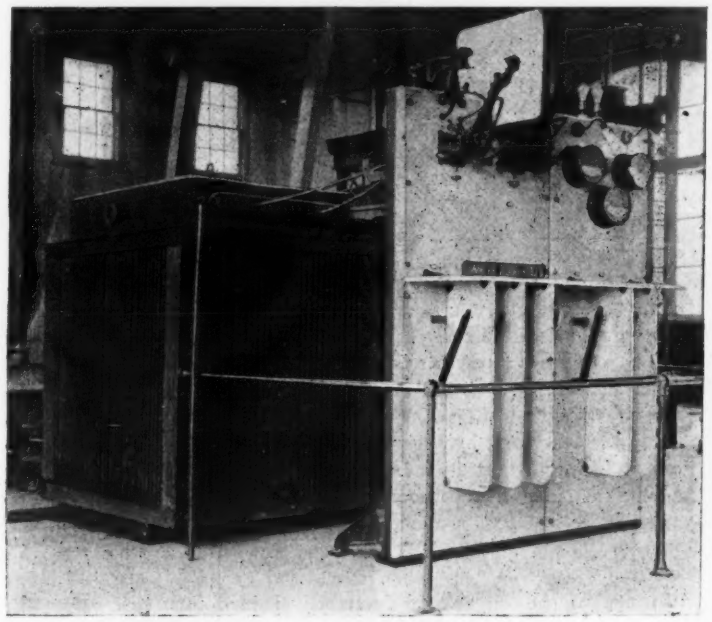


FIG 1.—TRANSFORMER IN NIAGARA FALLS POWER HOUSE.

right-hand panels may be used to parallel the line at the Niagara Falls Power Company's plant, as follows:

The two-phase circuits are closed, first the breakers, then the switches; the next switch of the three-phase circuit is then closed. The lamps will then indicate the conditions that exist in relation to both power houses. When the lamps go out, the next switch is closed; then the next.

The synchronizing transformers are connected across the first two wires, and although there are no synchronizing connections, which are unnecessary, the last switch may be closed at any time after the synchronizing has been done. However, it is not practical to parallel at this end of the line, for it would necessitate a very long wait, perhaps hours, before they would be synchronism, and the speed of the large alternators would have to be changed to bring about the results sought; so for this reason, this operation is performed at the Canadian end of the line.

After receiving word by telephone that their switches are all open,

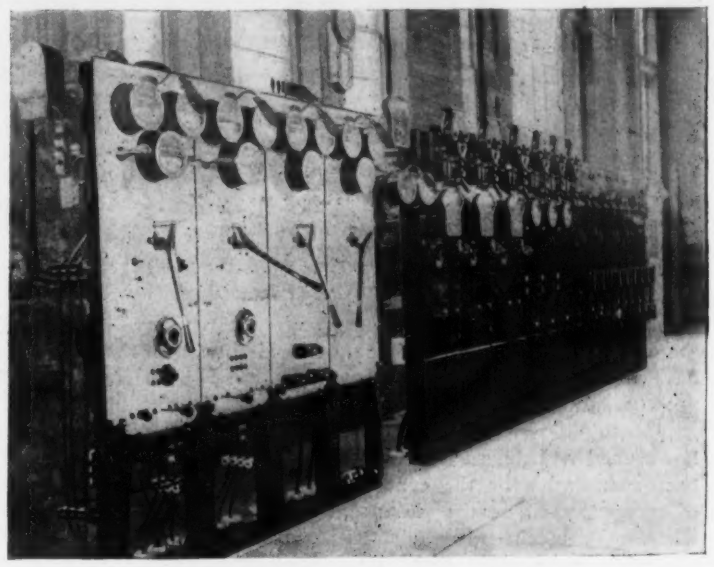


FIG. 2.—THE CANADIAN SWITCHBOARD.

the attendant at the Falls power house closes all circuits on the panels, and the Canadian Power Company is then notified that everything is O. K., when the synchronizing is done. The Canadian switchboard is shown in Fig. 2.

There are several important plants receiving current over this line from the Canadian branch, the principal one being the Niagara Falls, St. Catherine's and Toronto Railway Company. The Canadian alternators are illustrated in Fig. 3.

There is another transmission line to the Canadian power house, which carries current at 11,000 volts, three-phase. The current is taken from a panel which also supplies the Union Carbide Company with its several thousand horse-power. This current goes

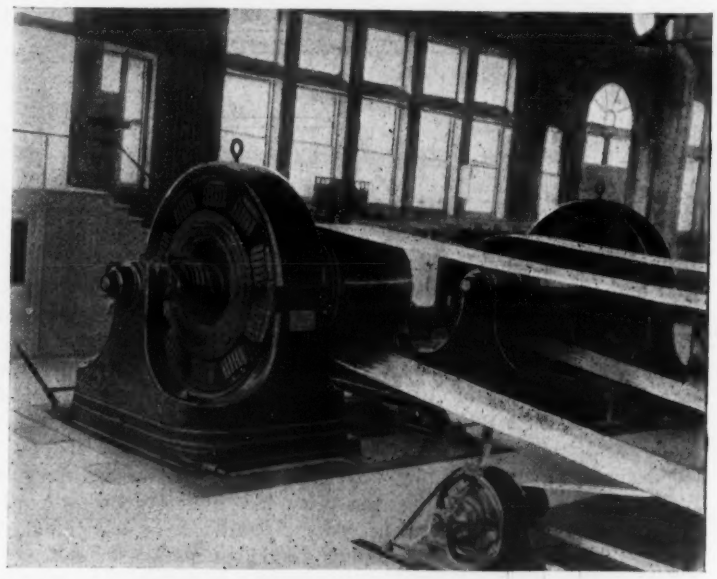


FIG. 3.—ALTERNATORS ON CANADIAN SIDE.

to an oil switch, motor actuated, thence to Canada. A three-wire cable is used throughout. A Thomson polyphase integrating wattmeter occupies a panel near by, which also carries the relay that opens and closes the oil switch.

The paralleling of this line is also performed at the Canadian power house. This line supplies current for A. C. Douglass, contractor, to operate a large motor for supplying air for the drills in tunneling.

The several transformers and panels at the Canadian power house in connection with this line were in use by the General Electric

Company at its lighting plant for the Electric Tower and other buildings at the Pan-American. No less interesting is the fact that the above-mentioned oil switch and panel were also a part of that famous lighting plant. It will be remembered that the oil switch was stationed on the top of its brick enclosure, back of the lighting panels. The cables from the water rheostat, in the "house on stilts," by means of which rheostat the Tower lights were dimmed and the beautiful effect of the gradual illumination of the grounds accomplished, came directly to this switch.

Within a few months, the paralleling of these power houses will be on a larger scale, and the present system but a detail of the whole.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

SULPHURIC ACID BY ELECTROLYSIS.

Faraday and a host of subsequent experimenters have investigated the electrolytic oxidation of sulphur dioxide in aqueous solution, and have found that under normal conditions one-half the oxide undergoes oxidation to sulphuric acid at the anode, the remainder appearing as sulphur or sulphureted hydrogen at the cathode. In 1895, however, Dr. Leonard Wacker succeeded in rendering the oxidation quantitative by the concurrent use or production of carriers of oxygen, such as the persulphates, or even the halogens. Mr. Charles B. Jacobs now finds that the same result may be accomplished by a judicious application of the principle that oxidation is facilitated by a concentrated solution and low current density at the anode. In Jacobs' apparatus the anode is a porous composition

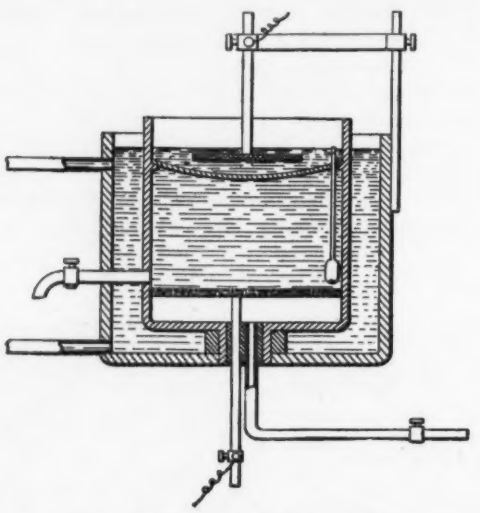


FIG. 1.—SULPHURIC ACID PROCESS.

through which the gas is injected in a continuous stream into the cell; and the anode area is 33 times that of the cathode. The accompanying Fig. 1 illustrates the arrangement used: the vessel is provided with horizontal electrodes, and an interposed diaphragm. The porous anode constitutes a partition near the base of the cell, and into the lower compartment so formed sulphur dioxide is injected through the pipe, passing through the previous anode and undergoing oxidation therein. An outlet is provided for withdrawal of the sulphuric acid when the hydrometer shall indicate that the desired density has been reached. A refrigerating jacket is provided in order that advantage may be taken of the increased solubility of sulphur dioxide at 0° C.

Jacobs, like Wacker, finds that by continuously injecting sulphur dioxide, the sulphuric acid may be brought to standard concentration. While, as stated, the reaction, chemically considered, is quantitative, all of the sulphur dioxide being converted, the electrolytic efficiency is given as 54 per cent.; this result is attained with a potential difference of two volts and a current density of 15-20 amperes per square foot of anode surface.

SOLUTION WITH CHANGE OF VALENCE.

According to Brown and Neil, tin is extracted from its ores or separated from scrap by solution in ferric chloride, the resultant mixed solution, comprising chlorides of tin and iron at their lower valence, then undergoing an electrolytic treatment to separate the tin and oxidize the iron; to this end, in the preferred procedure, the solution is caused to flow successively past the cathodes and insoluble anodes of a cell provided with a diaphragm. In the negative compartment tin is plated out, and at the anode the solvent salt is regenerated by return to its higher valence. This method is novel as applied to the treatment of tin, although it bears a resemblance to the Siemens copper process. In these questions, however, analogies are unsafe guides, for the commercial value must depend largely upon reaction velocities, and analogy affords no indication of these.

A case in point is the related method patented years ago to the late Dr. Carl Hoepfner, its purpose being to treat complex sulphide ores with cupric chloride, and subsequently to regenerate the solvent by the precipitation of one half of the contained metal. In practice the plan has developed defects, among them the slow and incomplete solvent action and the general unsuitability of the resultant solution for electrolytic purposes; for it is practically impossible to obtain a homogeneous electrodeposit of copper from cuprous chloride solutions in the presence even of traces of cupric chloride or of iron.

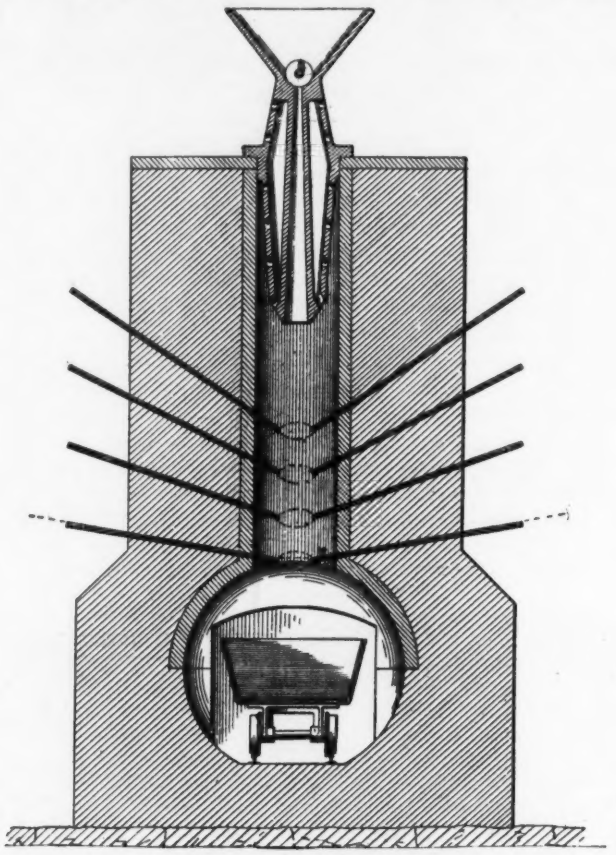


FIG. 2.—ELECTRIC FURNACE.

In a patent of current issue, granted to the administrator of Dr. Hoepfner, it is stated that these defects may be remedied by reducing the proportion of alkali metal chloride, added in the process of the earlier patent for the double purpose of dissolving silver and lead from the ores, and of holding in solution the cuprous chloride formed during the leaching; by such use of more dilute alkali chloride solutions it is found that an increased concentration of the solvent may be obtained, and hence more complete and rapid solution and deposition.

ELECTRIC FURNACES.

In one of the earliest of described electric furnaces, patented in 1853—a patent remarkable in that in days when the voltaic cell was the most available source of electric energy, the electrodes being of such enormous dimensions as would tax the resources of a modern power house—the mixed charge for reduction is described as falling freely and in succession through a series of arcs. This principle reappears in the smelting furnace recently patented to Dr. Frederick C. Weber, of Chicago. In Weber's construction the electrodes are arranged in several superposed rows, each comprising a number of opposing pairs of carbons, and the whole forming a vertically and laterally extended heat zone or sheet of arcs through which the pulverized charge is permitted to fall, the intention being to so adjust proportions and temperatures as to insure complete action. To fur-

ther this end the temperature of the several arcs may be graduated from above downward, independent current modifying means being introduced in circuit with each arc. An interesting though subordinate feature, useful because of the varying terminal voltage of the several arcs, is the divergent arrangement of the electrodes in both vertical and horizontal planes, with the purpose of avoiding current leakage through the heated walls. The accompanying diagram of the furnace is self-explanatory.

A patent to Hudson Maxim is identical in disclosure with that referred to in the issue of Oct. 19, 1901; in the present case, however, the claims cover the structure. The furnace is a rotary drum of complicated construction, wherein the fused carbide is said to be held against the inner periphery in the form of an incandescent bed, to which the charge may be fed, the excess of carbide floating out as formed from the open end of the drum. The main interest of the patent lies in the fact that it dates back to June, 1895, being a division of the earlier application filed at that time, and that the claims appear to cover, in words at least, the continuous operation with an incandescent body of carbide. One of these claims is as follows:

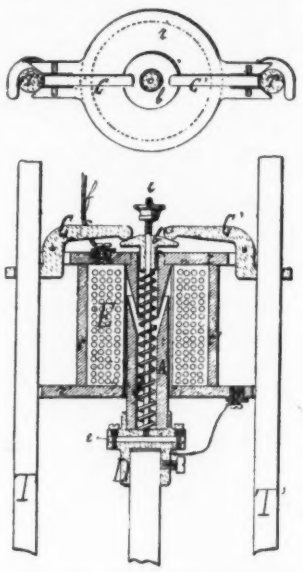
"In an electrical apparatus, for making calcium carbide, an electric circuit, a carbide conductor included in said circuit, whereby said conductor is maintained incandescent, and means moving the calcium carbide from the heating-field as fast as formed."

The Froment Enclosed Arc Lamp.

BY P. LETHEULE.

The recent appearance of a French enclosed arc lamp may be a matter of interest to Americans who have witnessed in their country such a rapid development of the same type of lamp. In the Froment lamp to which this refers, the inventors have done away with the usual pulleys, gears, rods and air dash-pots. The regulating mechanism is as follows: Rerferring to Figs. 1 and 2, between the frame rods, TT', slides an electromagnet, E. The passing of current in its winding lifts the moving core, A, which compresses the spring, i. This spring in its turn tends to lift the bushing C, which presses against the clutch levers cc'. These grip against the rods TT'', and they maintain the magnet in position as long as the current is kept on.

The action of the mechanism is as follows: The moving core, A, supports the upper carbon D, and the lower carbon is fixed on a cross-bar connecting the lower part of rods TT' and completing the



FOMENT ENCLOSED LAMP.

frame downward. When no current is passing the upper carbon rests on the lower one. If current is sent through the magnet, A lifts the upper carbon and strikes the arc, the length of which depends on the regulation of the springs. The lengthening of the arc increases the resistance in circuit, thus decreasing the current and allowing the spring i to lower down the armature A and carbon D. When the pressure is low enough on the bushing C and clutch levers cc', the magnet E slides down a small distance, and the same regulation takes place again, following the wear of the carbons.

Following are the comparative prices of lamps and accessories for a 110-volt system, according to the manufacturer's figures:

OPEN ARC LAMPS.		FROMENT'S LAMPS.	
2 lamps at 100 francs..	200 fr.		
1 rheostat	20 fr.	1 lamp	100 fr.
1 switch	8 fr.	1 rheostat	100 fr.
Installation of 2 lamps..	50 fr.	1 switch	8 fr.
(Comprising the necessary material).		Installation	20 fr.
Total.....	278 fr.	Total.....	128 fr.

The life being 150 hours, the saving in carbons is stated to be $1.30, the cost of a pair of carbons being estimated at 5 cents. A fact which should be mentioned is that time of trimming is neglected in the comparison. The estimate, therefore, appears rather liberal and well in accordance with the European conditions which subordinate cheap labor to cost of lamp and carbons.

Recent Storage Battery Patents.

In the Patent Office issue of July 15 the storage battery is represented by six patents, four of which relate to new types of plate, one to a forming process and one to a separator. The patentee of the latter is Hugh Rodman, the device described having already entered largely into commercial use. The material of the separator is wood, which is stated to possess unique and remarkable properties which adapt it to the purpose. Wooden sheets are arranged or formed so as to provide vertical passages to permit of free circulation on both sides, which is stated to be productive of remarkable results in increasing the efficiency, durability and capacity of a storage battery. A fibrous and porous wood such as bass is used, and the thickness of the diaphragms may be one-eighth of an inch more or less. Several forms of diaphragms are illustrated, some of which consist merely of wooden sheets grooved vertically or at a slight angle from the vertical in order to avoid ribbing the separator parallel with the grain. In still other cases a plain sheet of wood is used in connection with distance pieces.

A process of forming Planté plates is the subject of a patent issued to H. M. Martin, the principal feature of which is a cooling arrangement for keeping the electrolyte during the formation, below 115 degs. F. It is stated that by this means the peroxide produced in the factory formation can be made uniform and of the same kind. A patent issued to Victor Cheval and Jos. Lindeman, of Brussels, Belgium, relates to improvements of the type of battery in which the negative pole electrode is a single mass of active material having cylindrical or other suitably-shaped openings distributed throughout its mass, in which cartridge-like positive pole electrodes may be easily fitted, the intervening space being filled with the electrolyte. The positive pole electrode consists of a perforated insulating envelope having short exterior vertical wings extending from the corners. Within is a central conducting rod between which and the walls of the casing is packed active material.

Hermann Heinicke is the patentee of a peculiar form of plate which is corrugated vertically and supplied with horizontal strips inclining inward and connecting the outer portions of each groove formed by adjacent walls. J. B. Entz describes a metallic support constructed of rolled antimonious lead which is malleable by reason of the rolling, about 8 per cent. of antimony being contained. One form of plate is exceedingly thin, the thickness being only one millimeter more or less. This plate is bent so as to form ribs, the completed support having a corrugated appearance with flat intervals between the ribs or corrugations, which latter alternate on the two sides of the plate; in another form tangs, keys or projections made by punching project on either side of the plate. Both sides of the plate are finally pasted with active material of a depth sufficient to cover the projecting ribs or tangs.

A patent issued to Edward G. Steinmetz describes an improvement on the chloride type of storage battery. A salt of lead such as the chloride or acetate is pressed between dies in a stamping machine with sufficient pressure to make a solid block; or is mixed with water or other suitable medium and moulded to a shape and allowed to set and harden like cement. These blocks are then placed in a mould and a grid cast around them in the usual way. It is stated that the product obtained by this means is greatly superior to that obtained by the usual casting process, as the item of shrinkage in the mould does not need to be taken

into consideration and patterns or blocks are obtained of absolute uniformity, both as to structure and shape, with a freedom from the blow-holes apt to occur when the blocks are cast.

Meetings of State and National Contractors.

According to the programmes which were duly given in these columns, the New York State and the National Electrical Contractors' Association held their annual conventions last week, the State body gathering at Schenectady, where they were hospitably entertained by the General Electric Company, and the National, at the Franklin Institute, Philadelphia. As the proceedings are held with closed doors, in executive session, no regular report is available, but we are able to present some notes of what was done at the meeting.

At the Philadelphia meeting of the Board of Directors called to order by Chas. L. Eidlitz, chairman, at 10 A. M., Wednesday, July 16, there were present the entire board with the exception of E. T. Cooke, of St. Louis, who sent a letter stating he had sprained his ankle two days prior.

The roll call showed the following present: National President, Chas. L. Eidlitz, New York City; 1st vice-president, G. M. Jones, Minneapolis, Minn.; 3d vice-president, H. K. McKay, Baltimore, Md.; treasurer, Geo. R. Mathieu, Pittsburg, Pa.; secretary, W. H. Morton, Utica, N. Y.; sergeant-at-arms, J. C. Stearns, Buffalo, N. Y.; directors, M. L. Barnes, Troy, N. Y.; E. D. McCarthy, Buffalo, N. Y.; J. Hilton, Syracuse, N. Y.; H. A. Loeb, Philadelphia, Pa.; E. McCleary, Detroit, Mich.; W. I. Gray, Minneapolis, Minn.; J. K. Howe, Baltimore, Md.; E. E. Newbury, St. Louis, Mo.

The detail work was taken up with reports of committees on finance, publication and membership. The application of the Florida and Indiana Associations for membership were approved. Material generally was prepared for the meeting of delegates in the afternoon.

At 2.30 the meeting of delegates was called to order at the Franklin Institute by the chairman. Credentials were presented and Indiana and Florida were elected members. The committees were duly appointed. No fewer than 172 firms were represented out of a total of 206. Routine business was transacted for the remainder of the afternoon. The next meeting was called to order at 2 p. m. in the middle pavilion of the Steel Pier, Atlantic City, July 17, by the chairman. The appointment of several important committees was the first matter taken up. The entire constitution and by-laws were gone over and revised to meet the increased membership and changed conditions. The election of officers for the ensuing year resulted as follows: President, C. L. Eidlitz, New York, N. Y.; 1st vice-president, G. M. Jones, Minneapolis, Minn.; 2d vice-president, E. T. Cooke, St. Louis, Mo.; 3d vice-president, H. K. McKay, Baltimore. Md.; treasurer, G. R. Mathieu, Pittsburg, Pa,; secretary, W. H. Morton, Utica, N. Y.; sergeant-at-arms, J. C. Stearns, Buffalo, N. Y.; directors, E. D. McCarthy, Buffalo, N. Y.; J. Hilton, Syracuse, N. Y.; H. A. Loeb Philadelphia, Pa.; E. McCleary, Detroit, Mich.; W. I. Gray, Minneapolis, Minn; J. K. Howe, Baltimore, Md.; E. E. Newbury, St. Louis, Mo.; G. F. Sanborn, Indianapolis, Ind.; H. Anderson, Washington, D. C. There was considerable jealousy on the part of the Detroit and Minneapolis delegations, each wishing to have the convention for 1903. Minneapolis finally allowed Detroit to get it for July, next year.

The meeting was adjourned at 7.30 p. m. after a continuous session of 5 hours and 20 minutes with plenty of hard work.

The directors met again at 8 P. M., at the hotel parlors, settled some details and also met an important committee from another organization, of supply dealers. The directors agreed to meet in February 1903, at Buffalo, N. Y. The meeting adjourned at 10.45 p. m.

The New York State body came down the Hudson river on Tuesday evening, banqueted on the boat and joined the National party in New York on Wednesday morning, taking the excellent special train over the New Jersey Central arranged by Mr. Alex Henderson, master of transportation. The trip was highly successful and altogether too brief.

Following the afternoon meeting, a special boat was taken from the Arch street wharf, Philadelphia, for Washington Park, the "Coney Island" of the Quaker City; and, incidentally, a view was afforded of Cramp's shipbuilding yard. At the park, an admirable and luxurious dinner was provided, to which about 175 sat down, and it was not until about 12:30, midnight, that the majority returned to headquarters at the Hotel Walton. The local convention and reception committees are to be heartily congratulated upon the warmth and profuseness of their hospitality. These committees comprised Messrs. W. C. McIntire, H. A. Loeb, M. R. Mucklé, Jr., E. R. Keller, J. F. Buchanan, H. D'Olier, Jr., W. L. D'Olier, S. A. Jellet, H. G. Kepler, A. A. Lowry, F. E. McIntire, C. W. Pike, T. C. Smith, G. S. Smith I. C. Walker and R. C. Williams.

On Thursday a special train was provided in the morning which took the entire party to Atlantic City, where a good time was enjoyed while a larger amount of serious business was dispatched.

Not only were the contractors out in remarkable force, but manufacturing and supply concerns mustered strongly, making the affair an altogether notable one.

Power Plant on the Susquehanna.

Plans have been formulated for the erection of a new electric light and power plant on the Susquehanna River, near Conowingo Falls. It is not the first time that this affair has been put forth, but new life has been injected by Philadelphia, New York and Baltimore capitalists for the purpose of harnessing the Peach Bottom Rapids from a point just below McCall's Narrows.

On the rock-blasted islands on the river at that point the projectors will erect three enormous power houses, each of which will generate 50,000 horse-power. If this statement is correct, which is given out by the projectors, they will generate twice as much as the $3,000,000 power plant now being constructed by Judge W. F. Bay Stewart, of York, and Mr. Henry L. Carter, of New York City, at York Haven.

Engineers have been working at the problem for the past two years, and they now have their plans matured. The current, they allege, will go to Baltimore principally, and to Wilmington and other smaller towns en route. A large dam will be constructed about 1,400 feet long and 140 feet above tide water. Another will extend from the lower end of Piney Islands to Bare Island, a distance of 4,400 feet and a head race with a depth of 25 feet. This will pour into the great wheels 16,000 cubic feet per second. In each of the power houses will be installed ten 5000-h.p. electrical units. For each unit there will be three pairs of 48-inch turbine wheels.

It is stated that $12,000,000 will be needed to construct the great plant. Among those who have given their expert opinions on the work are: Dr. Coleman Sellers, of Philadelphia, president of the Niagara Falls Power Company; Clemens Herschel and John Bogart, consulting engineers on the Niagara works. At the head of this great undertaking is S. Davies Warfield, president of the Continental Trust Company, of Baltimore. Bonds will be floated in that city by the different banking institutions, and from the promises made this great project will be matured within the next two years.

Phonograph Evidence.

In a recent article the Nashville, Tenn., *Banner* notes the following: In a prominent residence locality in this city around a building which has been lately erected for the accommodation of a large number of renters, a stone quarry has been opened, where a squad of stone breakers are breaking up the rock, commencing their work daily at 4:30 o'clock A. M. By their noise they awake the denizens, and sleep thereafter is an impossibility. An injunction bill is being prepared, and, as it is almost impossible to describe in language the character of the noises produced, a phonographer has been employed to take the sounds on the spot. The phonographic tubes will be filed as exhibits, and when the case comes up in court they will be placed in an instrument and an auricular demonstration given, so as to enable the court to take in the thing complained of. It is believed that this is the first time that such an experiment has been resorted to in a legal proceeding." We may add that a similar use of the phonograph has been made in New York City. The test in New York, however, related as much to concussive and vibratory effects as to sound, and for this work variations of earthquake recorders or seismographs were found to be preferable. The latest Edison phonograph will record thunder, but is hardly equal yet to the flash.

Floods and Power Houses.

The past week or two have been notable for tremendous storms, and many power houses have been seriously flooded.

During the recent freshet at Waterville, Me., the power house of the Union Gas and Electric Company, of that place, was flooded, and the three large S. K. C. generators with which the station is equipped were completely submerged for 24 hours. The accompanying cut is from a photograph taken when the water was at its highest. The water is seen to be almost to the top of the windows of the first floor.

The water subsided slowly, and it was several days before access

FLOODED POWER HOUSE, WATERVILLE, ME.

could be had to the floor of the dynamo room. The generators were then carefully dried out and very thorough tests were made to determine if the insulation had given out at any point. No short circuit or other defect was found, and the machines were started.

To the great satisfaction of the company's officials, the generators were found to be absolutely uninjured, and they have been running ever since with their original normal efficiency. This is a typical instance of the effects of the heavy rains this season.

Telephone Meters.

The New York *Sun*, usually very intelligent in technical affairs, has the following note on the introduction of telephone meters:

"They have gas meters in your cellars which are supposed to register the amount of gas you consume, whether in or out of town. Now, a genius is at work on a telephone meter, which is to register the number of calls you have consumed under your contract. You are allowed, under this contract to have so many calls a year, but you have no idea how many you have consumed, and are dependent upon the telephone people entirely. In the proposed telephone meter you will have a machine which in some degree, like the gas meters, may tell you where you stand and then again it may not, just as a gas meter sometimes gets wobbly in summer time and registers just the same amount of gas consumed whether you are in town or not."

The great difference between a telephone meter and a gas meter is that the former will not be at the subscriber's station, but at the telephone company's central office. While this may seem off-hand like an arbitrary proceeding on the part of the telephone company, aimed at keeping the subscriber in ignorance of his use, it really has practical reasons that are easily explained. Gas that is used is burned either for lighting or heating, and, without disastrous consequences, cannot be used otherwise. The consumer expects to pay for light and heat; in other words, for all the gas that passes through the meter since all of it is used effectively. The meter can register his individual use only if it is connected to his individual supply pipes; therefore, the proper place for the gas meter is on the consumer's premises.

The telephone user, however, does not expect to pay for calls that do not result effectively. Many telephone calls do not result in effective messages, for a variety of reasons; the line wanted is "busy" or does not answer, a wrong number has been called, or the number called has been changed or discontinued, and so forth. Now, an automatic telephone meter would register simply calls and could not be expected to select for registration only those calls which result in effective messages. Consequently, since the telephone user pays for messages and not for calls, the place for the meter is not at the subscriber's station where it would register, whether operated mechanically by the rise of the switch-hook or electrically by the closing of the circuit, simply the number of times the telephone was used—a quantity always greater than the number of effective messages.

The telephone subscriber's line at the exchange end is just as much for his exclusive use as it is at the station end, or as the telephone instrument itself is, and the exchange end of the line is obviously the proper place for the meter. A selective meter which shall automatically distinguish between non-effective calls and completed connections is a practical impossibility, so it is necessary that the meter shall be operated selectively by some external agency, and the only means of doing this is to have the operator complete the operation of registering the message at the time she completes the connection which constitutes a message. The meter being at the exchange, besides ensuring an accurate record of the service rendered on each line, also much simplifies the work of reading them and of compiling the subscribers' accounts. Even under the present arrangement of recording by hand the use of each line it is not the fact as the *Sun* note states, that the user has no idea how many messages he has consumed, for it is the practice of telephone companies supplying measured service to notify each subscriber monthly of the state of his contract, giving the number of messages used during the month and the number remaining to the subscriber's credit at the end of the month. Presumably, this practice will be continued even when the use of meters becomes general.

CURRENT NEWS AND NOTES.

PARIS TROLLEYS.—A cable message states that Paris streets have just had a narrow escape from the introduction of a trolley system. The Est Parisien Company applied to the municipal council for permission, provisionally, to install overhead trolleys until it could change the existing plates, which have been electrocuting men and horses for two years past. The municipality fortunately remembered that in France *"Rien ne dure comme le provisoire,"* and refused the insidious proposal.

RAILROAD TELEPHONE LINE.—The Illinois Central Railroad's telephone line, which has been under construction for several months, is now completed and in operation through from Chicago to New Orleans, 922.65 miles; from St. Louis to Carbondale, Ill., 94.51 miles; between Grenada and Water Valley, Miss., 28.62 miles. This is a total now in operation of 1,045.78 miles of long-distance telephone line owned and operated exclusively by the Illinois Central Railroad for railroad business.

POWER ENTERPRISE FOR CHICAGO.—A special dispatch from Chicago, of July 22, says: City Electrician Ellicott is working on a plan for the development of the power from the flow of water in the sanitary channel, and its conversion into electricity for the operation of the lighting and water-pumping plants of Chicago, which plan he believes will solve the complicated question without a bond issue. Mr. Ellicott says there is a syndicate of Chicago capitalists figuring upon the matter, and it is probable that a proposition will be submitted to the Council during the Fall. The scheme contemplates the building of the development and transmission plant by private capital under a contract with the municipality, under which contract the city binds itself to pay as a rental for the use of the power developed a sufficient sum of money to guarantee a fair percentage on the actual investment. Any earnings aggregating more than this amount under the plan are to be turned over to the city, which reserves the right at any time to acquire the plant by the refunding of the bonds of the private corporation. According to Mr. Ellicott's plan, the city would not incur any greater obligation in the matter of rental than the cost of the coal bills of the city for the same purpose.

LABOR PROBLEM CONFERENCE.—A notice has been issued of the national conference of employers and employed. The dates are Sept. 22 to 26, inclusive, and the place is Minneapolis. On the local executive committee are Cryus Northrop and Thomas Lowry.

SIGNALS SENT FOURTEEN HUNDRED MILES.—A cable dispatch from London, of July 15, says: Marconi, who is on board the Italian flagship "Carlo Alberto," at Cronstadt, Russia, has cabled to his London office that he has received wireless signals from the Cornwall station, about 1,400 miles distant, partly overland. Complete messages were received so far as Skagen, Denmark, about 850 miles from Cornwall.

PLEASURES OF CABLE LAYING.—It is stated that the cable steamer "Anglia" while laying recently the Norfolk Island to Fiji section of the Australasian cable encountered a cyclone which lasted ten hours. No one could pass along the deck, the speed of the ship was reduced, although full power was maintained, and all had to remain at their posts. The cable was not lost, however, but the course was preserved and the work done creditably. An experience of this kind is a good test of the training of a cable ship's staff and crew.

TECHNO-LEXICON.—As announced some months ago in these columns, the society of German engineers (Verein Deutscher Ingenieure) has undertaken the compilation of a technical dictionary in English, German and French, and asks for the collaboration of American engineers. By addressing the editor in charge, Dr. Hubert Jansen, 49 Dorotheen Strasse, Berlin, collaborators, will be supplied with note-books and full information as to the plan of the work and the information desired.

WIRELESS PLANS.—A cable dispatch from London, of July 17, says: As soon as Marconi returns to this country from Italy, in about three weeks, steps will be taken to establish a regular service between Poldhu station, in Cornwall, an American station at Cape Cod, and a Canadian station at Cape Breton. Marconi believes that if all goes well he will be in a position before Christmas to send ordinary messages to Cape Cod or Cape Breton at sixpence, and press messages at twopence halfpenny a word. Connection of distant towns in Africa is also promised in the near future.

CONTRACT FOR PACIFIC CABLE.—The Commercial Pacific Cable Company signed a contract with the Telegraph Construction and Maintenance Company, in London, last week for the manufacture and laying of its cable from Honolulu to Manila, touching midway at Guam. The construction company guaranteed to complete the cable by June, 1903, if furnished with the necessary soundings. In the event that these cannot be furnished, the company agrees to finish the cable laying within such time thereafter as is necessary to take the soundings. Having two steamers capable of carrying 6,000 miles of cable, the company is able to complete within a year the work which would take other contractors two years to do. The steamer "Silvertown," at Woolwich, is now loading the San Francisco-Honolulu cable, 2,400 miles long, and is expected to sail for San Francisco in August. Eighteen hundred miles of this section have already been manufactured and are being taken on board the "Silvertown." The Cable Company has asked the United States government for its soundings, and has offered reduced rates for all official messages.

GOVERNMENT TELEPHONY.—The New York *Evening Post* notices the following incident: One of the dangers of the telephone where the service is in the hands of the government has been curiously illustrated in Germany. An association, of which a well-known German "captain of industry" is a member, recently found it necessary to ask him by telegraph if he was satisfied with a certain resolution passed by the society. The telegram was forwarded to Cologne by means of the telephone, and on its way the word resolution became revolution. This was enough to make the operators at the Cologne central turn over the dispatch to the secret police. With their customary wisdom, the latter saw in the message plain proof of a widespread anarchist conspiracy to overturn the Government, particularly as it was signed by an organized body. Forthwith two detectives rushed to the hotel and arrested the captain of industry on sight. Since the latter's name is known throughout Germany, he found it easy to prove his innocence and to explain the message. But what would have become of him had be been a foreigner, or an inconspicuous person from a far-off village, is something about which the knowing prefer to remain silent and look wise.

HORSE TRAINING has been undertaken by the Automobile Club of America, which has issued an instructive circular, or what perhaps might better be called a circular of instruction, to its members on the subject. One paragraph remarks: "It is far better to take a little trouble than to cause an accident which outside of damage to property may produce pain, suffering, and even loss of life. Horses that are used in or about large cities, and in towns where there are trolley roads, are but little frightened by automobiles. When, however, a horse unaccustomed to automobiles meets one in a quiet country road he is frequently frightened, he shies, sending the wagon into the ditch, or he turns around short and upsets the wagon. To accustom horses to automobiles in the country, some of the members of the club have with considerable success undertaken the training of horses in the communities where they reside. We desire to call this matter to your attention, and to ask every member of the club who can, either himself, or his mechanic (if he employs one), to devote an hour every morning to the training of horses in his vicinity during the next few weeks, and to report on Sept. 1st to the secretary the number of horses he has succeeded in training, and the effect his work has had on the community where he resides."

TROLLEYS IN MAINE.—It is stated that a remarkable expansion of the electric railway systems of Maine is promised within a year. The line from Bangor to Hampden is to be extended to Winterport, seven miles further down the river, and it is expected that ultimately this road will be extended to Frankfort, where are large granite quarries, and down the bay to Fort Point and Belfast. The Penobscot Central line, which for two years has been in operation from Bangor to East Corinth, 15 miles, has this summer been extended to Charleston, 21 miles from Bangor. In Kennebec County two roads are projected—one from Augusta to Waterville and Winslow, the other from Augusta to Belgrade Lakes and Oakland, the combined mileage of the two being 39 miles. Companies have been organized for the construction of these lines, and the capital stock, $200,000 in each case, has all been subscribed. A line from Augusta to Winthrop is nearly completed. A line is in process of construction between Portland and Brunswick; lines are being surveyed in Hancock and Aroostook Counties, and the project in which Governor Hill is largely interested, is for the construction of a road across the State from the Kennebec River to Penobscot Bay, by means of which passengers can be carried from Augusta to Rockland in two hours. At present there seems to be a prospect that within five years all the important cities and towns in Maine from Bangor to Biddeford will be connected by electric railways.

AUTOMOBILE ASH CARTS.—The street cleaning department of New York City may soon have automobile ash carts. Commissioner Woodbury is devoting a great deal of time to a study of the question. Three firms of automobile manufacturers are now at work on the problem of concentrating in one vehicle cheapness and serviceableness, and although the task is not an easy one the commissioner has hopes. The new automobile ash cart is to require the services of only one man, who will act as chauffeur and garbage collector simultaneously. It is to be covered with canvas, self-rolling, on a cylinder, on the same principle as a window shade, and is to have a top opening corresponding exactly in size with new garbage cans which it is the intention of the department to have adopted by all householders in the city. The new cans will be furnished with grappling irons, which, when suspended to a transverse bar on the cart, would act as hinges. Thus the can could be dumped with the same ease with which the lid of a box is lifted. The opening in the cart being exactly of the size of the can no ashes would be spilled, and immediately the can is emptied the canvas top, by rolling back automatically shut, would prevent the dispersion of ashes by the wind. The idea is borrowed from a bulky ash cart model submitted by a Berlin inventor, which only has the disadvantage of requiring four horses to move it and three men to operate it. By applying electricity as a motive power the necessity of the four horses is removed, and by reducing the bulk and the ash pockets the service of two of the three men are dispensed with.

ST. LOUIS FAIR.—Work was begun July 12 on the foundation for the tower which will carry the wires from the electric subway to the switchboard of the second-story gallery of the Palace of Machinery, at the St. Louis World's Fair. The foundation is to be nine and one-half feet below the floor of the building and to occupy a space 14 feet wide by 22½ feet long. All the current to be used for the light and power of the Exposition will be concentrated at the large switchboard. The current to be supplied by the Citizens' Company will be carried to the switchboard, and the current manufactured by the Westinghouse Company will also be concentrated at that point.

GERRYCIDE?.—Mr. N. Seaver, writing to the New York *Times* from Pittsfield, Mass., has the following apropos of Noah Brooks' article on "Purists and Words" in *The New York Times Saturday Review of Books*, of July 5: "I have had it in mind a long time to request *The New York Times Saturday Review of Books* to denounce the use of "electrocute," invented by some callow or careless reporter. I use the word electrocide (like suicide) as a noun or verb and was annoyed recently when it was changed to cute in a published article by a "compo" who knew what I meant better than I did. The same "compo" printed cross for crass. The sentence might read "shall be put to death by electrocide." In view of the fact that execution by means of electricity was devised and advocated by Elbridge T. Gerry, many electrical engineers call it "Gerrycide."

A BEEHIVE CABLE BOX.—While wax is an insulator, honey would seem to be a pretty good medium for a short circuit. When A. P. Green, manager of the Postal Telegraph Company, at Chester, climbed up to the cable box on top of a 50-foot pole in front of his office last week looking for trouble, and opened the box, he found there a mass of buzzing bees, a "million of them," is the way he expressed it. A swarm of bees had taken possession of the box and were filling it with wax and honey. Mr. Green slammed the door shut and got down in record time. He immediately reported the matter to headquarters, and now the officials of the telegraph company were last reported trying to get some thick-skinned or fearless man to ascend the pole and fish out the bees and honey, for it is said that they have stuck the Chicago and St. Louis wires together.

LETTERS TO THE EDITORS.

Long Distance Wireless Telegraphy and Hertzian Waves.

To the Editors of Electrical World and Engineer:

Sirs.—The first paragraph of Mr. Lee De Forest's discussion of July 5, of my article of June 14, is a clear and positive admission that *he* is familiar with "*popular* literature" upon the subject in hand. He then proceeds to attribute my "confusion of ideas" to that kind of literature. He presents no showing that I have ever read one word of "popular" literature.

As he brought up the personal element, and as it is only fair for me to correct this mistake concerning my course of reading, it may prove, in this connection, of some advantage to initial investigators, to present a partial summary of literature that I have come across. Numerous personal investigations required the most searching examination of every original work of scientists and inventors. I procured all of the 83 copies of United States patents, and I have devoured them. I examined the 100 British patents granted. Your standard ELECTRICAL WORLD AND ENGINEER stands at the top of all magazines as containing valuable contributions. Of special value is the Digest for putting one upon the track of articles in other periodicals. Among books are Fleming's "Electrical Oscillations and Electric Waves" (Cantor lectures of 1900); Fahie's "Wireless Telegraphy," useful especially as containing the first publication concerning Hughes experiments on electric waves, and Branly's paper on coherers. Prof. Jones' and other translations of Hertz's papers are essential. Finally, the investigator cannot be well posted until he has waded through the files of all *leading* American and foreign periodicals, and the translations of engineering societies.

Coming now to the main subject matter of the discussion, Mr. De Forest treats solely of a theory of the manner in which Hertzian waves or oscillating currents travel, or are conducted, or pass, or run, or walk, or jump, or slide (phraseology will not alter the fact that the waves get there) over, or in, or upon, or near, in the water skin deep, or in the ether in the water, or partly under the water, or in the ether which is near the water. My article admitted (see page 1046, paragraph 2) that my argument was independent of the manner in which the oscillatory current travels upon the sea. My argument was also independent of the inherent nature of aerial Hertzian waves.

My position is this: In addition to this form of energy, conveniently called oscillatory currents, crawling over the surface of the ocean, there is another form of energy, namely, the isolated electromagnetic aerial Hertzian waves, entirely detaached from all conductors, shooting like a ray of light tangentially to the earth and heavenward from the transmitting station, but not through the earth to a point 1,500 miles distant. My diagram on page 1047 will make my meaning plain. Mr. De Forest was neutral on this point as I understand him. I hold it as proved, and not a theory, that there are two distinct forms of energy—the one transmitted over the surface of a conductor, and the other propagated absolutely independently of conductors. Aerial Hertzian waves are as truly propagated in a rectilinear direction as Röntgen rays, or light, or heat. Fleming positively stated in his classical lecture, referred to hereinbefore, "We have then, in the first place, to notice the proofs that have been given that electric radiation sent out from a Hertz or similar oscillator resembles in all respects plane polarized light. . . . Moreover, this plane polarized light is susceptible of reflection, refraction and of producing interference with other rays." Being then, like polarized light, let us notice the consequence. Light would not follow the curvature of the ocean for 1,500 miles, nor could refraction or reflection bend it downward the required calculated distance of 16 miles or so.

We say that Röntgen rays travel as far as the most sensitive detector will indicate their presence. I say that aerial Hertzian waves will travel as far as a coherer will answer without a conductor. If the ocean is used as a conductor, for a distance of 1,500 miles around the curve of the earth, I say that the coherer is not operated by aerial Hertzian waves. I do not find that Mr. De Forest dissents from this conclusion.

In answer to Mr. S. M. Kintner's discussion (in the ELECTRICAL WORLD AND ENGINEER of July 12) of my article of June 14, I have little rebuttal, for the simple reason that he and I seem to agree that in regard to long-distance transmission, "It is time the Hertzian wave idea, as far as the rectilinear propagation is concerned, was abandoned." However, neither does he deny the existence of the overhead aerial Hertzian waves.

Having written my article, and having answered the published discussions, I now wish the opportunity of answering the silent objectors—those who listen but do speak not. They probably ask, "Of what practical advantage is it to know that aerial Hertzian waves fly up, and oscillatory currents remain below?" Shakespeare said, "Words without thoughts never to heaven go." Wireless messages do go heavenward, and hence it follows that all this radiant energy is lost. Is there not a problem presented, therefore? How can this radiant energy be saved and sent over the guiding ocean? An analogy may be observed in heat phenomena. In a boiler plant, radiant heat is saved by well-known expedients.

NEW YORK CITY. EDWARD P. THOMPSON.

Standardization of Advertising Literature.

To the Editors of Electrical World and Engineer:

Sirs.—Probably the greatest inconvenience experienced by those obliged to retain the numerous catalogues which are received, is caused by the fact that there are so many different sizes. There is really no good argument in favor of this large variety of shapes and forms other than perhaps the artistic effect which is occasionally secured.

For flyers, the size should be made 3½ in. x 6 in., but when it comes to standard catalogues where they cover lists, code words, etc., that are expected to be referred to from time to time and must be filed for reference, it is extremely essential that the 6 in. x 9 in. size of the book be considered if the best results are to be secured.

We have on file in our office about 3,500 catalogues and pamphlets and I find that there are more than 500 different sizes. It is self evident that to file these catalogues so that they will be convenient for reference is a most difficult matter and if they are not filed so that they can be conveniently referred to the

manufacturers represented are the losers. It would seem, therefore, that this fact alone would cause manufacturers to think well before they decide to use a mongrel size when making a catalogue.

Three sizes have been decided upon by, I believe, a committee appointed by the steam railroads a number of years ago, namely, 3½ in. x 6 in; 6 in. x 9 in. and 9 in. x 12 in. If all literature conformed to these three sizes the files of those who are obliged to keep them would be vastly improved and it would facilitate the finding of data concerning any particular product to an incalculable extent. The saving in time alone would be a very large item. Many times owing to the fact that catalogues have not been properly filed, days are sacrificed writing for a duplicate copy and an order is lost to a manufacturer that would have otherwise received the business had his literature been available.

Since coming with the Bullock Electric Manufacturing company I have rigidly adhered to standard sizes for all publications. I have never had occasion but in one instance to use the 9 in. x 12 in. size. All of my bulletins are made 6 in. x 9 in. and flyers have been 3½ in. x 6 in. These two sizes when proper attention has been given to the preparation of cuts would serve almost any purpose. Of course there are cases where perhaps the 9 in. x 12 in. size would be the more desirable, but at any rate there seems to be no good excuse for departing from these three sizes.

I believe that if the technical press of this country would take the matter up vigorously through their editorial departments, and by drawing the attention of manufacturers to the subject in various ways it would finally result in standardizing this class of literature, and the gain to manufacturers both to the seller and to the purchaser would be very great indeed.

CINCINNATI, OHIO. FRANK G. BOLLES.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Twenty-five Thousand-Volt Direct-Current Dynamo.—SOULIER.—An illustrated description of the high-tension, direct-current dynamo designed by Thury and used for testing purposes on one of his direct-current series system transmission plants, as recenly noticed in the Digest. A revolving field and a stationary armature are used. The field is bipolar, the exciting coils are connected to two slip-rings, and obtain the exciting currents from a small separate dynamo. The fixed armature is outside and has 48 coils, each consisting of 500 turns of wire of 0.8 sq. mm. cross-section. The machine gives 1 ampere at 25,000 volts, at a speed of 600 r. p. m., the internal armature resistance being 700 ohms. In the commutator, which has 48 segments, air insulation is used; as the voltage between two segments may become 750, it is necessary to prevent the formation of sparks between the segments under all circumstances. A pair of movable brushes which are revolved from the field system and insulated by means of several insulating materials in series, conducts the high-tension current to two very well insulated slip-rings, from where it flows to the terminals of the machine. Essential devices for the prevention of sparks are air blast and condensers; the air blast consists of a fan mounted on the shaft of the machine so that its action is the stronger, the greaer the speed and the higher the tension. Condensers are connected each to two consecutive segments of the commutator. All insulations are made with the greatest care.—*L'Ind. Elec.*, June 10.

REFERENCES.

Equalizing Connections on Direct-Current Armatures.—ARNOLD.—An illustrated English translation in abstract of his German paper, noticed before in the Digest.—Lond. *Elec. Eng.*, June 13.

Direct-Current Armature.—EICHBERG.—An illustrated article on some practical applications of a graphical method for representing the potential of direct-current armature windings.—*Zeit. f. Elek.*, April 27.

Alternators in Parallel.—An account of the work done by a committee of the International Society of Electricians in Paris, concerning the governors of steam engines for driving alternators. There is a long paper, illustrated by diagrams, by Guilbert, on the influence of the engine governors upon the operation of alternators in parallel. There are also shorter notes, by Blondel, Rateau, Miet, Guilbert, van der Stegen, Picou, Vigreux and Brillie and Chevrier.—*Bull. de la Soc. Int. des Elec.*, April.

LIGHTS AND LIGHTING.

REFERENCES.

Train Lighting.—JACQUIN.—The first part of a very long paper read before the International Society of Electricians in Paris, in which he gives a summary of the different methods of electric train or car lighting. He first discusses the lighting of trains by storage batteries only: either the whole train is supplied with current from one or two batteries, or the single cars have individual batteries. Different installations are described; first such in which the batteries are charged in a station, and then such in which they are charged on the train. He then discusses those systems in which dynamos are used on the trains. The following systems are dealt with: lighting of a total train from one or two dynamos mounted in hte car wheels; lighting from dynamos, driven by special prime movers, with or without the use of a battery.—*Bull. de la Soc. Int. des Elec., May; L'Eclairage Elec.*, June 7, 21. In the second part of his paper he describes the systems of Stone, Vicarino, Aubert and improvements introduced by himself.—*Bull. Soc. Int. des Elec.*, June.

Arc Lamps.—HOPPE.—An article in which he gives numerous tables of comparison of the economy of enclosed and open arc lamps. He shows that all claims that enclosed arc lamps consume less energy per cp than open arc lamps are wholly unfounded.—*Elek. Anz.*, May 14.

POWER.

Electric Power for Agricultural Purposes.—HAAS.—An abstract of a paper in which he discusses the use of electric power in agricultural districts, with special reference to the experience gained in connection with the electric tramway in operation in Hanover, Germany. There are 48 villages connected to the distributing network of the Hanover tramways, and 35 of these, with a population of 37,500 persons, have no system of gas lighing at their disposal. The results obtained from these localities are as follows: At the end of 1899 motors of a total of 440 hp were connected to the mains, and at the close of 1900 these had increased to 1,251 hp, while at the end of 1900 a further advance to 2,049 hp had been made. The greatest demand of electric power was for the operation of thrashing machinery, and to a less degree for driving pumps, hay presses, straw cutters, etc. Of the total hp installed, 77 per cent. represent purely agricultural operations and 8 per cent. factories, although the former only yields 53 per cent. of the receipts. On an average the annual revenue per hp installed amounted to about $7 (as compared with from $17.50 to $37.50 in towns) at a price of 4.8 cents per kw-hour, and the average period of use did not reach 150 hours, as against 500 hours in towns. Electric light in agriculture is not of the same importance as electric power. The lamps are installed in fair numbers, but are not used; farmers retire early and rise early; it happens that in the case of an installation of 30 lamps in one house only a single 5-cp lamp is regularly used. In towns the revenue per lamp installed amounts to about $3.50 per year with a lighting period of 450 hours, whereas in the 35 villages the average sum realized reaches only $1.62 per lamp installed, and a consumption extending to 260 hours. He concluded from the experience in the Hanover district that satisfactory results are possible in agricultural operations only, where cables already exist for the transmission of power or for the operation of electric tramways, and which can readily satisfy the small and occasional demand for agricultural purposes.—Lond. *Elec. Rev.*, June 27.

REFERENCES.

Steam and Gas Engines.—WITZ.—A long comparison of steam engines and gas engines, concerning their price, the certainty and regularity of operation, and the consumption of water. He concludes that the gas engines can compete advantageously with steam engines under certain conditions, if they are carefully installed and treated and chosen with regard to the service that they have to render.—*L'Eclairage Elec.*, May 24, 31.

Electric Pumping.—FRY.—An illustrated description of an electrically-driven pump, recently installed at the Oneida mine, at a 1,300-foot level. It is geared to a 100-hp, 440-volt, three-phase induction motor, running at 580 r. p. m. The pump lifts 197.5 gallons per minute to the surface.—*Jour of Elec.*, June.

Electric Pumps.—BOWIE, JR.—A paper, with map, on the proposed electric pumps for stock wells of the Kern County Land Company for irrigation. It is proposed to distribute current at 3,300 volts, single-phase to the different pump stations, where it is to be stepped-down to 110 volts.—*Jour. of Elec.*, June.

Oil as Fuel.—An article giving data from New Orleans, Mobile and other cities regarding the utility and efficiency of Beaumont oil as fuel in street railway power stations, with some data on the saving secured, and on the oil burning apparatus.—*St. R'y Rev.*, June 20.

TRACTION.

Electric Tramways.—RIDER.—His presidential address to the Brit. Municipal Electrical Association. He points out the economies resulting from combined lighting and traction stations. There are now in England 36 electric street tramways in operation, which are owned by the municipalities, and 16 others in progress; 28 of the former are supplied with current from a municipal combined lighting and traction station, and 11 of those in progress will be so supplied; there are also four instances in which the municipal station is supplying current to tramways owned by companies. He then compares the trolley and the conduit systems; he thinks a conduit system is justified only when the traffic over the lines is so great that the heavy capital charges do not make any serious addition to the cost per car-mile; this is a condition of things only met with in metropolitan cities, and even then there is no reason why the overhead system should not be used. The conduit system becomes necessary under such circumstances only when the rights for the tramway can be obtained only on the condition that the conduit is used; or when the system of lines is so complicated that the overhead construction becomes cumbersome and dangerous. Concerning guard wires, he says that they may be a protection in some few cases, but in most of them they are the means of causing the very accidents which they are intended to avoid. Neither guard wires nor any of the numerous similar devices strike at the root of the matter, which is to prohibit entirely uninsulated wires of any kind crossing the trolley wires. If telegraph and telephone wires must be erected overhead they should be allowed to cross the streets only at right angles, the spans should be kept exceedingly short, and the wires carried as high up as possible, in order that a broken wire may not reach the street. They should be insulated at such crossings, and if guards are insisted upon, in addition to the above, they should be in the form of a netting or similar arrangement under the telephone wires. —Lond. *Elec.*, July 4.

REFERENCES.

Electric Railways.—LEON GERARD.—A very long paper read before the Belgian Society of Electricians, and occupying the entire April number of 100 pages of the *Transactions*. It is, in some respects, almost a treatise on certain parts of the subject of electric railways. The first chapter is on a comparison of steam and electricity for traction, the result of his comparison being favorable to electricity. The second chapter is devoted to road beds of electric railroads. The third and last chapter deals with the lines, systems, motors, etc. In some general conclusions he discusses the probable substitution of electricity to replace steam on the present steam roads, coming to favorable conclusions. At the conclusion there are a few tables, in which electric railways are classified in various ways, each class being accompanied by some data. The paper contains numerous illustrations. It it too long to be abstracted here; it appears to be a very good collection of information concerning European electric railways. It seems to refer very largely to other systems than the typical trolley system of this country; there are frequent references to polyphase traction. The paper contains but few references to electric railroads in this country.—*Bul. Soc. Belge. d'Elec.*, April.

Conductivity of Rails.—WOODFIELD.—An article giving data on the conductivity of track and collector steel rails as affected by their chemical composition.—Lond. *Elec. Rev.*, June 27.

Baltimore.—An illustrated article on the increased power facilities for the United Railways and Electric Company, of Baltimore, Md.—*St. R'y Jour.*, June 20.

Measuring the Power of Automobiles.—MUELLER.—An article in which he discusses the proper method of defining and measuring the power consumption of an automobile. He criticizes unfavorably a method proposed by Gasnier.—*Centralbl. f. Accum.*, May 15, June 1.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCES.

Haggerston.—An illustrated description of the new electric station of Haggerston, which is designed on a large scale, although only two units have at present been installed, each being a steam engine coupled to a 800-kw, 1,100-volt, d. c. dynamo.—Lond. *Elec.*, June 20.

Salford.—The first part of an illustrated description of the Salford municipal lighting and traction plant. The direct-current system was adopted with a declared pressure of 220 volts for lighting, on the three-wire system, which permits power to be supplied to motors at 440 volts. The same generators are also used to supply power to the tramways at 500 to 550 volts. The capacity of the plant is 6,400 kw.—Lond. *Elec. Rev.*, June 27.

German Central Station.—An illustrated description of the electric lighting and power station in Erfurt, a city of 86,000 inhabitants; 3,000-volt, 50 period, three-phase current is used for transmission to a converter substation. The e. m. f. of the direct-current system is 100 volts.—*Elek. Anz.*, June 1, 5, 8.

No-Load Losses in Transformers.—WINKLER.—An illustrated review of various suggestions which have been made to diminish the no-load losses of transformers in alternating-current systems.—*Zeit. f. Elek.*, May 4. Some notes by Schlatter and Winkler on the same subject in *Zeit. f. Elek.*, June 1.

High-Tension Switches.—VOGELSANG.—A long illustrated description of new high-tension switches, cut-outs, automatic circuit breakers, fuses, etc., made by Voigt & Haeffner. In all of them the arc is distinguished by the well-known action of bent horns.—*Elek. Anz.*, June 19, 22, 26, 29.

WIRES, WIRING AND CONDUITS.

High-Tension Cables in Frankfort.—SINGER.—An abstract of a paper read before the Frankfort Elec. Society, on high-tension cables. At Frankfort, concentric cables have been used for transmitting 3,000-volt alternating current. Troubles which have been experienced have been found to be due not to the quality of the cables but to the fact that the outer conductor has a tension of 80 volts against earth, while the central conductor has nearly 3,000 volts against earth. Many accidents were due to earths of the central conductor. A careful double insulation has been applied with success. In the past few years, however, it has been decided to use "stranded cables" instead of "concentric" ones for high-tension transmission, and since that time there have been no more bad accidents.—*Elek. Rundschau*, May 15.

"Sparklet Fuse."—An illustrated description of a so-called "sparklet" fuse devised by Partridge for breaking a 10,000-volt spark between contacts ½ inch apart. The "sparklet" is a small steel capsule containing liquid carbonic acid under considerable pressure. It is so placed that if the arc continues, the cap of the sparklet is melted off, and the carbonic acid gas coming off under pressure effectually blows out the arc. Partridge proposes to use the "sparklet" on switches and automatic cut-outs in place of the carbon break.—Lond. *Elec., Elec. Rev.*, July 4.

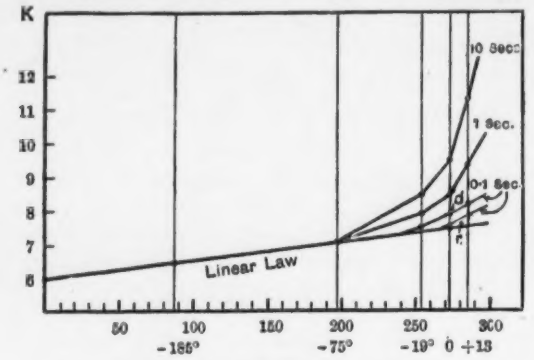
Capacity in Transmission Lines.—SARTORI.—An article in which he shows that the capacity of a wire at a given distance from the earth is twice that which would be due to another wire at twice the distance. He works out numerically the case of an overhead transmission line of three wires, and shows that neglecting the effect of the earth and considering only the effect, of the wires on one another, may lead to an error of over 50 per cent.—*Electricista*, Feb.; abstracted in *Science Abstracts*, June.

REFERENCE.

Oscillations in High-Tension Lines.—POMEY.—A mathematical note on oscillations of very high potential which may occur on high-tension lines.—*L'Eclairage Elec.*, May 10.

ELECTRO-PHYSICS AND MAGNETISM

Dielectric Constant.—CURIE AND COMPAN.—An account of a determination of the dielectric constants of various glasses, mica, ebonite and quartz, all at low temperatures. It appears that for instantaneous charges the dielectric constant is a linear function of the absolute temperature. For temperatures above —75° C. a charge lasting for one second, and still more if it lasts for 10 seconds,

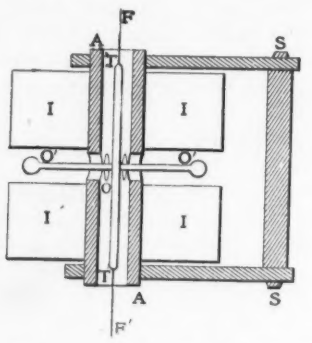


CURVE OF DIELECTRIC CONSTANT.

entirely alters the character of the curve. In the adjoining diagram this is brought out by showing several values of the dielectric constant for the same temperature. Moreover, there is some hysteresis indicated by the difference of the two curves *d* and *r*, where *d* means that the temperature is proceeding downwards and *r* that it is proceeding upwards.—*Comptes Rendus,* June 2; abstracted in Lond. *Elec.*

Rotating Hysteresis.—SCHENKEL.—An illustrated account of experiments in which he determined the rotating hysteresis as a function of the induction up to high values. The rotating hysteresis increases slowly at first, then more quickly, then again more slowly, and reaches a maximum at the induction B = 16,000. It then decreases very suddenly and seems to approach asymptotically the value zero. At $B = 23{,}000$ it is already so small that it is only 8 per cent. of the maximum value.—*Elek. Zeit.,* May 15.

Electrostatic Effect of Magnetic Variation.—CREMIEU.—A description of a new experiment, which, like the others described by him before, is intended to show the incorrectness of Maxwell's theory. He appears to prove that the making or breaking of a magnetic circuit produces no impulse upon an electrostatic charge placed at its center. In the adjoining diagram, a closed magnetic circuit *A S S A*, excited by the coils *I I I I*, contains an iron tube,



ILLUSTRATING ELECTROSTATIC EFFECT OF MAGNETIC VARIATION.

A A, in which a light metallic rod, *T T*, is supported by a thin wire, *F*, and held by a silk thread *F'*. Suitable openings in the iron tube allow six light horizontal bars, *o o'*, to penetrate the walls, and to the outer end of each bar is attached a metallic sphere 15 mm. in diameter, or a sector of 20 degrees. The spheres or sectors are charged through the wire *F*, and every time the coils are excited an impulsive deflection should theoretically be shown by the spheres or sectors. The result, which according to Maxwell's theory should be very perceptible, is always nil. He, therefore, maintains that no electric force is created in dielectrics by magnetic variations.—*Comptes Rendus,* June 16; abstracted in Lond. *Elec.*, July 4.

REFERENCES.

Lag and Lead.—RHODES.—A mathematical article in which he discusses the exact meaning of the terms: phase difference, lag and lead for any wave form.—Lond. *Elec. Rev.,* June 13.

Arc.—JANET.—An article on the peculiar physical properties, and especially of the acoustic properties of the Voltaic arc.—*Rev. Gen. de Sc.,* May 15.

Rotation of Electrolytes in Magnetic Fields.—DRUDE.—A final reply in his polemics with Urbasch. He maintains that the latter was mistaken in the observations in his experiment.—*Zeit. f. Electrochemie,* April 24.

Atmospheric Electricity and Lightning Protection.—A very long article summing up a very large amount of experience which had been collected in recent years by numerous investigators. A summary is also given of the various theories of atmospheric electricity. The main result is that nothing certain is known yet. Concerning lightning conductors, it is shown that among various people there are rather inconsistent ideas on the duties of a lightning conductor. The rules given by various individuals and committees for the best construction and arrangement of lightning conductors are summed up.—Lond. *Eng'ing,* May 30, June 13, 20.

Cyclone Theory of Magnetism.—COTTRELL.—The first part of an illustrated article describing the experiments of Weyher, who tries to explain the facts of magnetism by an analogy with cyclonic motions. His investigations in their inception were extensions of experiments undertaken to reproduce the meteorological conditions attendant on all cyclonic motions in the air, and in any other gaseous or liquid medium.—Lond. *Elec. Rev.,* June 27.

ELECTRO-CHEMISTRY AND BATTERIES.

Welsbach Storage Battery.—MUGDAN.—A discussion of an accumulator, recently patented by Auer von Welsbach, the inventor of the incandescent gas light mantle and of the osmium lamp. His cell consists of zinc amalgam, zinc sulphate, cerous and ceric sulphate carbon. The amalgamated zinc electrode is at the bottom of the cell, the carbon electrode is at the top of the cell and consists of a fabric or of sheets of elastic graphitized carbon. During discharge zinc dissolves and ceric sulphate is reduced to cerous sulphate. During charge the reverse action takes place. An arched diaphragm of parchment or porous clay is used; it prevents any pieces of carbon from falling down upon the zinc plate, it also prevents mixing of the electrolytes, and causes any bubbles of hydrogen gas which arise, to escape upwards along the sides. The e. m. f. is not given, but is said to be higher than that of the lead accumulator; the inventor also claims that the capacity is a multiple of that of the lead cell. Continuous stirring is necessary. When the cell is used on automobiles, the vibrations of the carriage are sufficient; but for stationary purposes mechanical stirring devices are required. The large surface of the carbon electrode gives such a good depolarization that even at rapid charging scarcely a gas bubble is developed, but some gas is then developed at the amalgam electrode. The writer thinks that the cell seems durable, with the only exception of the carbon fabric, which he thinks may be easily replaced. The efficiency may be poor, on account of the diaphragm and the poor conductivity of the electrolyte. There is also a slow action of the zinc amalgam upon the electrolyte; the inventor thinks, therefore, that his cell is best suitable for purposes where the discharge follows the charge immediately. If a small particle of carbon would fall upon the zinc plate it would prove very serious, as it would produce a small short-circuited cell, acting continuously.—*Zeit. f. Elektrochemie,* May 3.

Point of Cut-Off in Accumulator Discharges.—BIENAIME.—Referring to a reprint of an A. I. E. E. paper on this subject by Hering, he describes the method used by his company. He admits that it is incorrect to adopt the usual method of stopping at 1.8 volts when discharges of the same accumulator, but at different rates, are compared with each other, or in comparing different batteries with each other. He believes the method which he uses overcomes the difficulty. It consists essentially in measuring the difference of potential, not only on closed circuit but immediately upon interrupting the circuit, the circuit being interrupted momentarily at each reading; this measurement gives him the e. m. f. at that moment, that is, it does not include the drop of e. m. f. due to internal resistance. The discharge is then continued until this e. m. f. on open circuit has decreased to a certain value which is the same for all tests (but he does not say what it is). This short article is accompanied by a set of curves taken from an actual case, giving the e. m. fs. on open circuit, the potential differences on closed circuit, the internal resistance calculated therefrom, and the density of the acid for all the points of a five-hour discharge.—*L'Ind. Elec.,* May 25

Storage Battery Discharge Curves.—M. U. SCHOOP.—An illustrated account of an experimental investigation of the condition under which the first part of a discharge curve of a storage battery shows the following feature: When the discharge begins the e. m. f. drops suddenly to a minimum, increases again a little, and then decreases continually. By a great many discharges under varied conditions he investigated the various factors which determine the appearance of the e. m. f. minimum. As the thickness of the plates has great influence upon the phenomenon, he concludes that it is caused by the diffusion of the solution of lead sulphate. He thinks that the following explanation, given by Dolezalek, is the most probable. When the discharge begins, the acid is used up for the formation of sulphate, and the concentration of the acid decreases in the pores of the plates which causes a decrease of the e. m. f. Sometimes, but not always, a minimum of e. m. f. follows, "which may, perhaps, be caused by the formation of an over-saturated lead sulphate solution; the solubility of lead sulphate in acid of about 20 per cent. decreases considerably with the dilution, so that it is quite possible that for a short time an over-saturated solution is formed at the beginning of the discharge when there is only a little solid lead sulphate; the increase of the lead sulphate concentration would then cause a diminution of the e. m. f."—*Centralbl. f. Accum.*, April 15, May 1.

Calcium Carbide.—ROTHMUND.—A paper on the temperature of formation of calcium carbide. After some theoretical discussions, he finds that 1,620° C. is the lowest temperature at which carbide can be formed; conversely at 1,560 degrees finely powdered carbide is changed back into calcium oxide and carbon, in the presence of carbon monoxide.—*Nachr. Ges. Wiss. Goettingen,* May 29.

BORCHERS.—An abstract of a lecture, in which he describes experiments made in a special furnace. He concludes from them that calcium carbide is not formed at a temperature below 2,000° C.—*Zeit. f. Elektrochemie,* May 29.

An illustrated article giving brief descriptions from patent specifications of numerous improvements in the industrial manufacture of calcium carbide.—*Zeit. f. Elektrochemie,* May 29.

GRUA.—The cost of calcium carbide per ton, $30.05, is made up as follows: Lime (950 kegs), $2.85; coke (750 kegs), $4.20; electrodes, $8; power, $10; wages, $5.—*Jour. de l'Electrolyse,* No. 139; noticed in *Elec. Chem. & Met.,* May.

Calcium Silicide—MOISSAN AND DILTHEY—An abstract of a paper on calcium silicide $Ca\ Si_2$ The material they obtained is similar to that prepared by Woehler, Chalmot and Jacobs The silicide prepared by the last named, however, reacts upon water in the same way as calcium carbide. Moissan treats 35 grammes of lime and 35 grammes of pure silicon in a carbon tube with 600 amperes at 60 volts. The crystals obtained are grey, sp. gr. 2.5; "they react very slowly upon water, yielding up hydrogen without the formation of silicon."—*Jour. de l'Electrolyse,* No. 138; abstracted in *Elec. Chem. & Met.,* May.

Electrolytic Production of Alkalies and Chlorine.—HARDEN—A brief summary. He first gives some data on the cost and then discusses the difficulties arising in practice. As the current is very great, about 2,000 amperes in an industrial bath at 3.5 to 4 volts, the conductors to the baths are difficult to make, and expensive. In general 30 to 40 boxes, each containing 6 to 8 cells in parallel, are connected in series across the 120 to 160-volt bars; any number of such series may be connected across the bars. One of the greatest difficulties is with the electrodes; in general artificial carbon is used; in smaller plants, platinum-iridium anodes are sometimes used, but it is not yet proved that they really resist any attack by chlorine; the author believes they are attacked; as they are very expensive, such an attack would be fatal. Ferro-silicium anodes are also said to be used at some plants, but no distinct information concerning them is available. Concerning diaphragms, he says that a really good one is not yet known.—*Elek. Anz.,* May 18, 22.

Electrolytic Production of Chromate of Lead.—LE BLANC AND BINDSCHEDLER.—An account of an experimental investigation on Luckow's electrolytic process of making lead chromate; he uses a 1.5 per cent. aqueous solution of a mixture, consisting of 80 parts chlorate of sodium and 20 parts chromate of potassium; the anode is of soft lead, the cathode of hard lead; the electrolyte is neutral; the e. m. f. for a distance of 1.5 cm. between the electrodes, is about 1.8 volt; the current density 0.005 ampere per square centimeter. During electrolysis the electrolyte is kept neutral, and both water and chromic acid are added carefully. The authors state that the formation of lead chromate takes place in a very satisfactory way. From the anode the lead chromate which is formed, drops down like an avalanche, the anode itself remains bright and is not covered with a layer of lead chromate or peroxide of lead. The ampere-hour efficiency is between 98.5 and 99 per cent. The authors then changed the relative proportion of the sodium chlorate and sodium chromate, while the total concentration was kept constant at 1.5 per cent; the effect is very remarkable; with 65 per cent. of chlorate and 35 per cent. of chromate, the electrode was covered with an adherent layer of lead chromate, mixed with peroxide of lead, the efficiency being 46 per cent. With equal parts of chlorate and chromate there was strong evolution of oxygen with an adherent film of chromate and peroxide on the anode, the efficiency being nearly zero. They tried to find why the addition of chromate is necessary for a good production of lead chromate with a high efficiency; they believe that in this case the molecular layers in the immediate neighborhood of the anode soon become poor in $Cr\ O_4$ ions, and that, therefore, the lead chromate is not found in this case immediately on the surface of the electrode. The principal point is, therefore, the constitution of the layers of electrolyte immediately at the electrode surface. They found that mechanical stirring apparently has an unfavorable effect.—*Zeit. f. Elektrochemie,* May 1.

Electrolytic Production of Persulphates without a Diaphragm.—MUELLER AND FRIEDBERGER.—An account of an experimental investigation, in which they found that persulphate can be made conveniently without a diaphragm process, while the voltage is considerably lower, being 5.9, as against 8 volts. Persulphate of potassium can be made in acid solution without a diaphragm with an ampere-hour efficiency of about 35 per cent. at a high cathodic current density. Persulphate of ammonium can be made, with an addition of chromate, at an ampere-hour efficiency of 80 per cent. by starting from a neutral solution and adding sulphuric acid to neutralize the ammonium hydroxide which is being formed.—*Zeit. f. Elektrochemie,* April 24.

Platinum and Platinum-Iridium Anodes in Hydrochloric Acid.—BRAN.—An account of experiments which show a great influence of the current density upon the chemical resistivity of platinum and platinum-iridium anodes in the electrolysis of hydrochloric acid. It is curious to note that the lower the anodic current density used, the more are the anodes attacked. If the current density is different at different points of the anode, it is attacked to a different degree at the different points.—*Zeit. f. Electrochemie,* April 10.

Cathode Pulverization in Alkaline Solutions.—HABER AND SACK.—An account of an investigation of the experimental fact that lead, tin and other metals, when used as cathode in alkaline solutions, pulverize; zinc and cadmium do not show this phenomenon. They show that an indeterminate step, preceding the pulverization, is the formation of an alloy of the cathodic metal with the alkaline metal, and a loosening of the cathodic surface. Alloys of lead and sodium, or tin and sodium, made by chemical means and placed in water, show the same phenomenon of pulverization; zinc does not, because it forms no alloy with sodium. The mercury cathode and the behavior of sodium amalgams were also studied by the authors.—*Zeit. f. Elektrochemie,* May 1

Direct Combination of Chlorine with Carbon.—LORENZ.—A note referring to the article of Bolton, recently abstracted in the Digest. He remarks that a direct combination of chlorine with carbon has been observed before. For instance, Woehler's method of estimating carbon in steel.—*Zeit. f. Elektrochemie,* April 10.

REFERENCES.

Steel Direct from the Ore.—The conclusion of the illustrated description of the Harmet electric furnace process, for the production of steel direct from the ore.—*Elec. Chem. & Met.,* May.

Electrolytic Reduction.—TAFEL AND SCHMITZ.—An account of an experimental investigation of the reduction of organic substances which are difficult to reduce, in sulphuric acid solution, at lead and mercury cathodes. For such reductions the choice of the proper cathodic material is very important. They compared the reducing action at mercury and lead electrodes; also at vertical and horizontal lead electrodes. They also studied the reduction at amalgamated lead cathodes and at tin amalgam cathodes.—*Zeit. f. Elektrochemie,* May 8.

Electro-Analysis.—BINDSCHEDDLER.—An account of some experiments concerning the electro-analysis of mercury in mercuric chloride.—*Zeit. f. Elektrochemie,* May 29.

Electrolytic Analysis.—ARTH.—An article on Koch's method of estimating copper contained in iron, and of Mueller's method of the analysis of iodine in the presence of bromine and chlorine.—*L'Eclairage Elec.,* May 24.

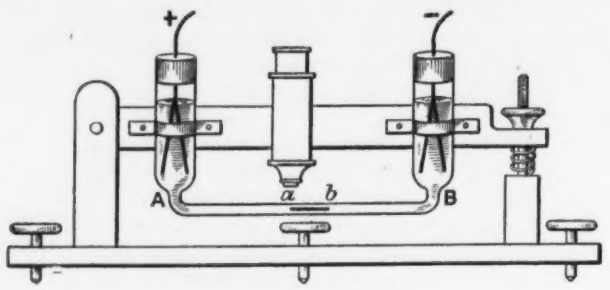
Electric Laboratory Furnace.—HERAEUS.—A description of an electrically-heated laboratory furnace for high temperatures; it is of the resistance type. For the heating spiral he uses sheet platinum of about 0.007 mm. thickness instead of platinum wire.—*Zeit. f. Elektrochemie,* April 10.

Ozone.—GRAEFENBERG.—A preliminary account of an experimental investigation of the potential of ozone. The e. m. f. of the ozone-hydrogen gas cell is 1.66.—*Zeit. f. Elektrochemie,* May 15.

Hydrogen Electrode.—PANCHAUD DE BOTTENS.—A long illustrated account of an experimental investigation of the lowering of the potential of the hydrogen electrode, due to the presence of substances of the aromatic series.—*Zeit. f. Elektrochemie,* May 22, 29.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Capillary Electrometer.—HOULLEVIGUE.—A description of a new form of capillary electrometer, shown in the adjoining diagram. A



CAPILLARY ELECTROMETER.

drop of mercury, *a b,* is placed between two columns, *A B,* of the acidulated water, the current being introduced through platinum electrodes. An e. m. f. of 0.00005 volt suffices to bring about a legible displacement of the mercury, and the apparatus may be rendered even more sensitive by reading; "not the actual displacement, but the rate of displacement on tilting, which undergoes a perceptible acceleration or retardation on applying the e. m. f." For getting rid of bubbles, etc., the drop is brought into the wide tubes. *Jour. d. Phys.,* June; abstracted in Lond. *Elec.,* July 4.

REFERENCES.

Testing Insulators.—RITTER.—An illustrated description of the installation of the high-tension testing plant of a German porcelain works and of the methods used there for testing the porcelain insulators for transmission lines. Insulators which are to be used at 5,000, 10,000, 20,000, 50,000 volts, are tested at 20,000, 30,000, 50,000 and 100,000 volts, respectively.—*Elek. Zeit.,* May 29.

Brake Dynamometer.—GRAU.—An illustrated description of an electric brake dynamometer for measuring up to 5 hp. It is a larger piece of apparatus of the same type as described by him before, and noticed several years ago in the Digest.—*Elek. Zeit.,* May 29.

Standardizing Tests of Sheet Iron.—BENISCHKE.—A long communication in which he criticises several points of the standard rules proposed by the hysteresis committee of the German Society of Electricians.—Eng. *Elek. Zeit.,* May 22.

Wattmeters and Meters for Alternating Current.—ARMAGNAT.—An article giving brief ilustrated descriptions, mainly from patent specifications, of several new instruments: the Duncan wattmeter; the device of Steinmetz for taking into account the wattless current; the Johnson meter; the Siemens & Halske modification of Ferraris meters; a three-phase meter of the General Electric Company, of Berlin, a four-wire, three-phase Aron meter; a Siemens & Halske three-phase meter, consisting of two Ferraris wattmeters.—*L'Eclairage Elec.,* May 17.

Measurement of the Internal Resistance of Cells.—WEBER AND ROBERJOT.—An illustrated article on new methods for measuring the internal resistance of cells. They discuss the use of the Kelvin double bridge, and of the Wheatstone differential bridge, and the influence of polarization.—*L'Eclairage Elec.,* May 10.

Hot-Wire Instruments.—REYVAL.—An illustrated description of the Chauvin and Arnoux hot-wire ammeters and voltmeters, which have been noticed before in the Digest.—*L'Eclairage Elec.,* May 10.

TELEGRAPHY. TELEPHONY AND SIGNALS.

REFERENCES.

Telegraphy and Telephony.—The quarterly summary of progress and new inventions, giving brief descriptions taken from patent specifications and descriptions in journals.—*Elek. Anz.,* May 25, 29.

Submarine Cables.—DEVAUX-CHARBONNEL.—A long illustrated article on the determination of the dimensions of a submarine cable for a given purpose; and on the propagation of the current and the speed of transmission.—*L'Eclairage Elec.,* April 26, May 3.

MISCELLANEOUS.

Fusion of Quartz.—HUTTON.—An illustrated description of some experiments. He first used an open arc; when quartz is fused in the arc, reduction takes place in the immediate neighborhood of the are and causes a black stain on the surface which disappears when the heated mass is held for a short time away from the center of the flame; in fact the working of quartz in the arc flame much resembles the working of lead glass in the ordinary blow pipe, excepting that there is an immense difference of temperature. He then fused quartz in closed electric furnace. A Moissan arc furnace was modified by cutting passages in the sides, so that a carbon support charged with quartz could be passed under the arc and at right angles to it. A current of 300 amperes at 50 volts was usually employed. To produce thick-walled tubes of quartz, with a core of about ⅛ inch a rough mold is made of carbon with a carbon core, resting at each end on carbon supports; the mold is filled with broken-up quartz not too finely powdered. The tubes obtained in this way can easily be separated from the carbon support and the core be withdrawn. He has not yet succeeded in preparing tubes quite free from bubbles, but the general appearance can be greatly improved by re-heating under the arc, preferably with mechanical rotation.—*Elec. Chem. & Met.,* May.

REFERENCES.

Steel.—HAHN.—An article in which he gives a summary of the magnetic properties of the sorts of steel used in electrical engineering.—*Elek. Anz.,* May 4, 8.

Heating Apparatus.—An illustrated description of new electric heating and cooking apparatus of the General Electric Company, of Berlin.—*Elek. Mitt.,* April.

Dusseldorf Exposition.—An article giving brief description of the various electrical exhibits.—*Elek. Anz.,* May 8, 11.

New Book.

ELECTRICAL AND MAGNETIC CALCULATIONS. By A. A. Atkinson, M. S. New York: D. Van Nostrand Company. 310 pages, 45 illustrations and wiring tables. Price, $1.50.

This excellent book is one of the really helpful additions which have recently been made to the technical literature of its subject matter; and it raises to the dignity of serious consideration what in the past has been rather unpretentiously represented by the electrical arithmetics of sundry writers. Some 12 or 15 years ago, when our educational institutions were beginning to organize courses of instruction in electrical engineering, Cumming's "Theory of Electricity" was a typical textbook used; and those familiar with such books will recall that the theory was largely imparted through computations. Though the problems were usually absurdly academical, still the method must be confessed to have been most practical. Following this stage the tendency seemed to have been toward a descriptive statement of theory and applications; and this in turn has developed into the precise mathematical statements which characterize the late books. In these changes computation seems to have been largely lost sight of, and skill in its use has been left in some sort to the practice of engineering to impart. Professor Franklin seems to have been cognizant of this tendency, for in his second edition of "Alternating Currents," 1901, he has added "a very complete series of practical problems with answers." No doubt every technical course of study in electricity does now include more or less computation; but there is reason to believe that its relative importance in the work of instruction has been suffered to decline.

For reasons that are not difficult to discover, in our most practical country the definition of the "practical" has come to be laid in "experience"; but the broader view is slowly obtaining that the "practical" man is he who knows the available theory of his subject and has the needed skill for its application. And following out the suggestion in the routine of instruction in technical electricity, or its acquisition by self-instruction, the progress in the theory of electricity and magnetism should be enforced step by step with sufficient computation to acquire needed skill and mastery. It must be remembered, too, that the most elaborate mathematical statement of theory is not quantitative until every phase of it has been gone over

in actual computation. In fact, no portion of mathematical or descriptive theory is of much consequence to the engineer until it can be applied with ease and certainty in calculation.

This book by Professor Atkinson thus makes a valuable contribution to electrotechnical literature in that it covers the definite theory of electricity and magnetism, and enforces each phase of it with admirably clear and practical computation. Though the book is the outgrowth of class work and will prove especially valuable to the schools, yet the engineer will find in it a helpful means for review and clarifying what has been heretofore vague; while for those who are pursuing self-instruction, the book will be one of the most helpful aids that can be obtained.

The book is introduced by a discussion of units and their numerical relations. The work proper covers the subjects of resistance, current, electromotive force and energy; alternating currents; wiring for light and power; batteries; magnetism and the relation of magnetic quantities, and the calculations involved in dynamo and motor design. One of the most noticeable things in the early portion of the book is the clear and precise discussion of compound circuits, and it is doubtful if anything approaching it in excellence can be found on the same subject. As illustrative of the methods of the book, Chapter IV, on electrical energy, after a satisfactory treatment of energy in general, is given to the calculation of the fuse; the efficiency of transformation and transmission, of generators and plants, and of luminous translating devices. The following chapter on alternating currents takes a middle ground in its theoretical exposition. The simplified formulas are stated though not derived, and their terms are defined; and this is done with such clearness and precision that those who are familiar with the complete analysis of periodic phenomena can read the chapter with interest, and by following the computations will, doubtless, derive benefit; while those who are debarred from such knowledge will be enabled to apply the formulas in calculations with a degree of confidence and intelligence.

More than one-third of the book is given to the development and discussion of the principles of design of magnetic apparatus, especially of dynamos and motors, both alternating and commutated. In the quantitative or numerical treatment this portion of the work is to be preferred to similar discussions in the books of Professor Sheldon or Jackson, while for purposes of instruction it is superior to the too diffusive treatment of Wiener. The letter-press of the book is tasteful and pleasing, and the paper and binding are excellent, and are an improvement over the similar features of books published by this firm. An exhaustive index adds greatly to the value of the book.

The style of the author is clear and pleasing, and the very numerous problems which illustrate the text are so fully worked out that no one can well fail to understand the theory here presented; while the large numbers of problems for solution are judiciously selected, most of them being seemingly original with the author. The book purports to have been developed in class work, in which the problems and theoretical statements have been tested and revised. The technical fraternity is under obligations to Professor Atkinson not only for the large amount of labor involved in the preparation of such a work, but for the successful manner in which it has been accomplished.

Variable Speed Motors for Direct Drive.

A constantly increasing demand for the direct driving of individual machine tools, as well as many other classes of machinery requiring independent direct drive, has made necessary a study of construction which will result in a motor that will stand up under a wide, varying range of work, be compact and of such a design that it will adapt itself to this class of work. Compactness, durability and high efficiency are some of the features that must be complied with to meet these requirements. These considerations have been followed in thedesign of the Storey motor. It is cylindrical in shape and its compactness in proportion to its hp. output makes it specially adaptable for direct connection to all classes of direct driven machinery and tools. Notwithstanding its small dimensions, entirely enclosed and both dust and moisture proof, there is no undue heating even under full load and continuous operation. It has no external magnetism and can be placed in any position regardless of other surroundings.

One of the peculiarities of this machine is the varying of the speed directly through the field of a straight shunt-wound motor. These machines are in every day use with a varying speed of 200 per cent. through controlling or cutting out the field by means of an ordinary field control, the same as used to control fields of generators, but of high resistance sufficient to cut out the field to give the required speed. The claims for these motors are that they will maintain the same horse-power at any point throughout the full range of speed variation of 200 per cent.

That the Storey Company has confidence in its product is demonstrated by the way in which it has applied it to the driving of the main tools in its machine shop. Fig. 2 shows one of the motors applied to a large slotting machine, made by the Betts Machine Co., of Wilmington, Del. Fig. 3 shows the motor applied to driving a Reed lathe, 29 in. swing. This lathe is equipped with a 3-hp motor which is 12½ inches in diameter and has a variation of speed of 200 per cent., giving it a slow speed of 500 and a high speed of 1,500 revolutions. This variation of speed with the Storey system of direct drive of lathe gives a range of speed at the spindle of the lathe from 3½ revolutions to 300 revolutions, and the lathe can be operated at any speed from the lowest to the highest. There is no multiple of voltages, no multiple of field control and no resistance in the armature circuit. The motor is always operating on a direct line at full voltage, thereby

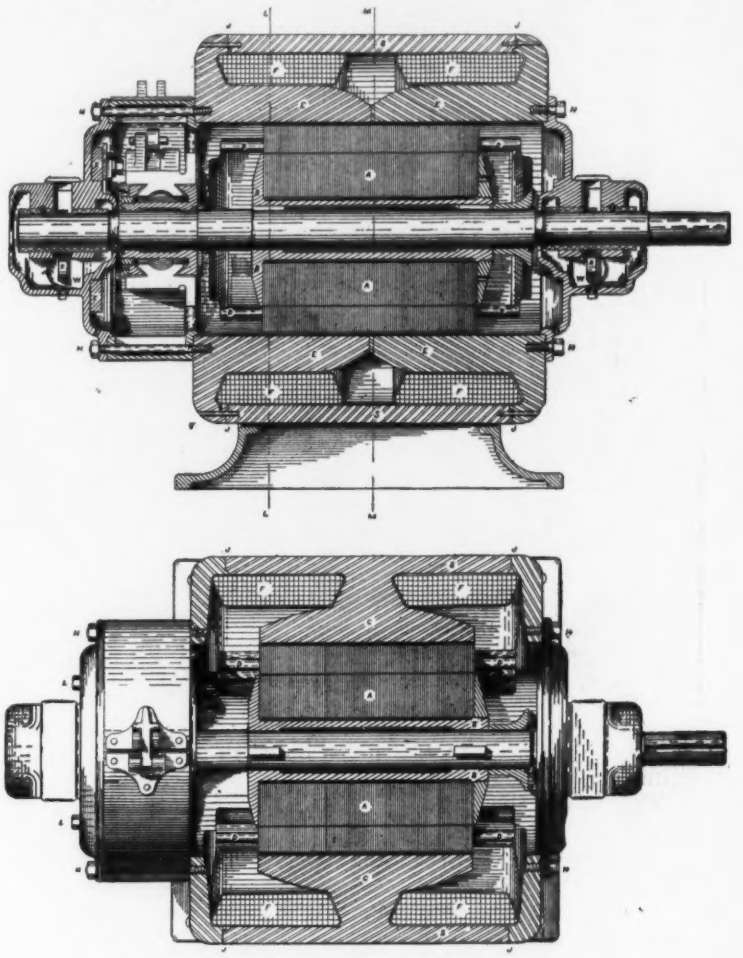


FIG. 1.—STOREY MOTOR, SECTIONAL VIEWS

attaining the highest efficiency. There is a small field control on the front of the lathe (in easy access to the operator) in series with the field circuit, whereby the operator can cut out and cut in the current in the field to attain the required speed. This lathe is provided with a suitable mechanism, whereby it can be stopped and started from the tool carriage, a great convenience, which will be much appreciated by the machinist. The motor can be reversed, running the lathe in either direction. This is done through a reversing starting rheostat having a double pole, quick-snap break switch, operated from the front of the lathe or the carriage. A safety stop is provided which cuts off the current before the carriage travels too far to do damage.

In the case of the motor driving the large slotting machine, which is a 3½-hp, 110-volt shunt motor, the field current of 1.55 amperes is reduced to .20 ampere by steps, the speed increasing from 600 revolutions to 2,400. Although the speed of the motors may be varied repeatedly between these limits, there is no perceptible sparking at the commutator. There is a constant increase in load from the lowest to the highest speed, due to the fact that the quick

return of a slotting machine requires more power than the cut, and this increases constantly as the speed increases, working the motor at the highest horse-power output at the highest speed, a rather unusual performance for a motor of this size and capacity.

The motor is very largely used for driving portable drills or apparatus of similar character, and is equipped with a special starter. The lever of this starting box can be controlled by a cord which can be manipulated in any desired manner. The operator can pull the lever slowly over to the full speed running position, thereby starting the motor. An additional pull of the cord draws the lever somewhat farther along and disengages a catch, thereby allowing it to fly to the off position and cut off the current.

Fig. 4 illustrates a variable speed electrical tool grinder. Attention may be called to the starting device, which comprises a lever and push button. The motor is started by turning the lever, which is pulled upward and caught by a trip. This trip is held by an ingeniously arranged solenoid magnet which would instantly release it should the motor lose its current or its field in any way; or should the motor become overloaded from any cause, another action comes into play, releasing the trip and allowing the lever to fly back to its off position. Pressure on the push button effects the same result mechanically, thereby stopping the motor. Below the push button is located a little knob which controls the field rheostat and enables the speed of the motor to be varied within wide limits.

The motors on the larger tools are controlled by a convenient form of controller, shown in Figs. 5 and 6. This controller consists of a cylinder containing appropriate resistance coils, and quick-break

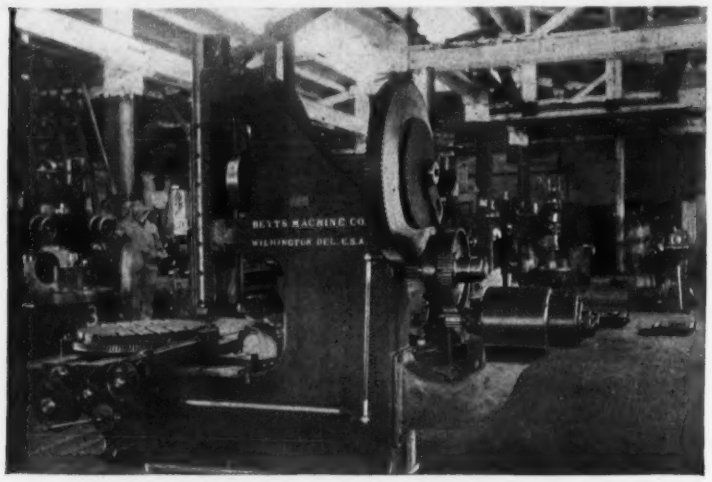


FIG. 2.—MOTOR DRIVING SLOTTING MACHINE.

switches which are properly manipulated by the mechanism for starting and stopping and reversing, the handle being moved to the right for rotation in one direction and to the left for rotation in reverse direction.

The application of the motor to other machine tools is quite as satisfactory, owing to its compact and convenient form, high range of speed, etc., and it is the intention of the company eventually to equip all of its machinery with independent motors. At present the interior of the machine shop a building 55 x 115 feet, presents a marked contrast. One side is driven entirely by independent motors, while the other has the old system of belts and countershafting. This room, illustrated in Fig. 2, represents an appearance which very forcibly illustrates the advantage of individual motor driving.

The motor has only two field coils, which are circular in shape and surround the armature concentrically. The field coils are wound on spools and then wrapped with three layers of muslin soaked in linseed oil. After thoroughly drying they are wrapped with three more layers, similarly treated, and then baked. It may be remarked here that the use of vegetable insulating compounds, especially tapes treated with vegetable oils, are to be preferred on account of the greater dielectric strength. This is particularly necessary in field coil work, because of the reactive kick of the field coils when suddenly open-circuited.

The armatures, on the other hand, are mica insulated, with a view to having the structure resist high voltages. The armature coils are form wound and put in the slots of the core in mica troughs. The armature coils are taped automatically by an ingenious taping machine. All of the machinery in the winding department is driven independently by separate motors, thus doing away with belting and counter shafting. In the testing room each machine is given a thorough test, being run at full load for three hours, and subsequently light for two days.

The field frame of the motor consists of a cast-steel cylinder with two poles cast on the inner surface in diametrically opposite positions. In Fig. 1 is shown a cross-section of these poles, which

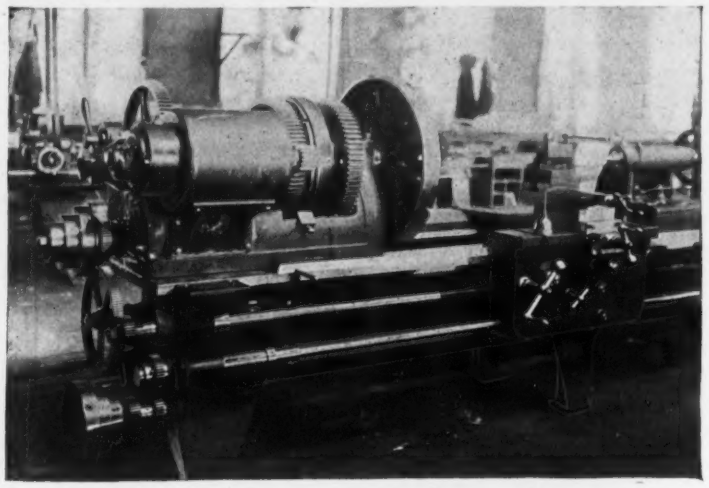


FIG. 3.—MOTOR DRIVING 29-INCH LATHE.

are lettered *C*. At 90 degrees removed from these poles are two other poles, lettered *E*, cast on flanges which form the ends of the fields and which, with the before mentioned cast-steel cylinder, complete the magnetic circuit. Field coils, lettered *F*, surround the armature and polar structure, the magnetic circuit being from *E* through the cylinder *S* to *C*, and through the armature back again to *E*. This makes a very short and effective magnetic circuit, particularly adapted to the compact and enclosed type of motor which the manufacturers aim to produce.

The bearings of the motor are castings bolted to the pole pieces and are self-oiling. The commutator bearing is extended beyond the frame far enough to accomodate the commutator and brushes, and the open places between the supports are surrounded by a circular steel band clamped together by a suitable clamp, which renders the commutator and bearing accessible. The bearings can be rotated with reference to the frame by simply altering the bolts securing them in position, thereby enabling the motor to be run either hanging from the ceiling or side walls or upon the floor, the moving of the bearings being simply to keep the oil wells in proper position.

The armature is built in the usual way of discs clamped on the

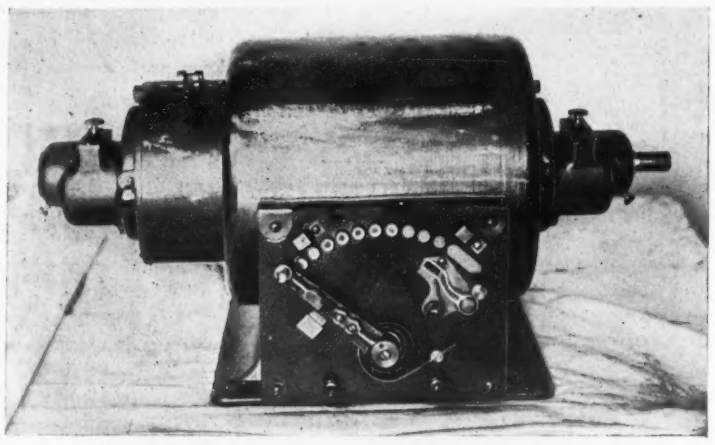


FIG. 4.—MOTOR FOR PORTABLE APPARATUS AND TOOL GRINDER.

shaft with paper insulation, except that the discs are assembled on a sleeve, which is keyed to the shaft, thereby making the latter removable without taking down the laminated structure. The commutator is mounted on a separate sleeve and keyed to the shaft also; it is liberal in dimensions and well insulated with mica.

The motor is now built in sizes from one-half to 50-hp. It is largely used for grinding, buffing and polishing, for which purpose the smaller sizes are used. The special design of this motor makes it particularly valuable for buffing work. The speed is con-

stant under varying loads or overloads, and the high speed necessary for this class of work is easily acquired with this motor, without any undue heating. The manufacturers claim that the heat rise is only from 60 to 70 degrees F., when the buffs are running at a speed of 3,300 to 3,500 r.p.m., and the machines are in constant use from ten to twenty hours per day.

The Storey Motor & Electric Co., of Harrison, N. J., has been producing motors for a number of years, and its enclosed type of motor has figured so largely in electric installations as to make the name well known. The company has been steadily increasing its facilities and now has at Harrison, N. J., a well equipped fac-

FIG. 5.

tory for producing its product in sufficient quantities to meet the growing demand.

The factory is built in the shape of a large T, having a total floor space of about 17,000 square feet. One of the rooms of the

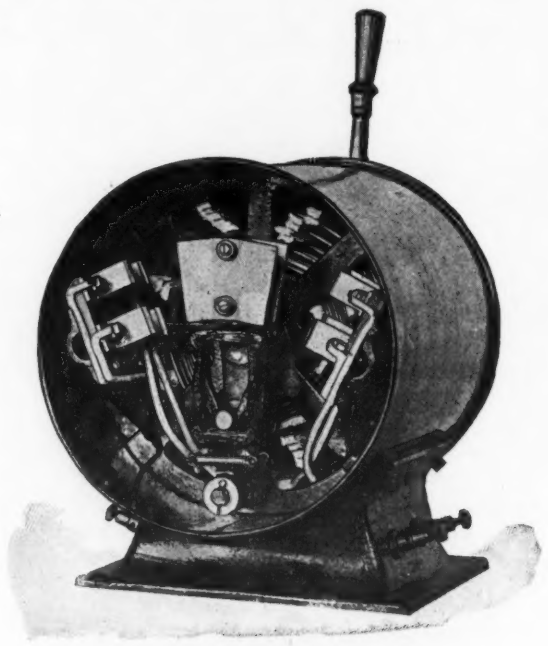


FIG. 6.

T is devoted to the offices, drafting room and pattern shop. In the other arm are located the winding and testing rooms, while the stem of the T is devoted to machine shop and dynamo room facilities. The winding and testing room is combined, forming a space 60 x 66 feet, and equipped with a 5-ton traveling crane. In this room are wound the armatures and field coils of the motors.

The De Forest-Smythe Wireless Telegraph System.

ABOUT a year ago a new American system of wireless telegraphy was announced, which was invented and up to that time developed in Chicago. Since that time the De Forest Wireless Telegraph Company has been incorporated under the laws of the State of Maine, by New York capitalists, laboratories and workshops have been opened in Jersey City, two regular stations equipped on opposite shores of New York Bay, between which messages have been exchanged daily for some months; another station for long-distance communication with ocean-going and coast-wise vessels has been opened at Coney Island, and others are now in progress of erection. Two boats of the Knickerbocker Steamship Company are being equipped with the system, while the Ward Line ship "Morro Castle" carried on board an outfit on her last trip to Havana.

The receiver, or "responder" as it is aptly called, depends on an electrotyptic principle for its action. It is claimed that this receiver will respond with absolute certainty and regularity to a spark of one-sixty-fourth inch length from a small coil 40 feet distant, driven by one cell of storage battery with a 2-foot antenna at receiver and coil, and without ground connection at either end.

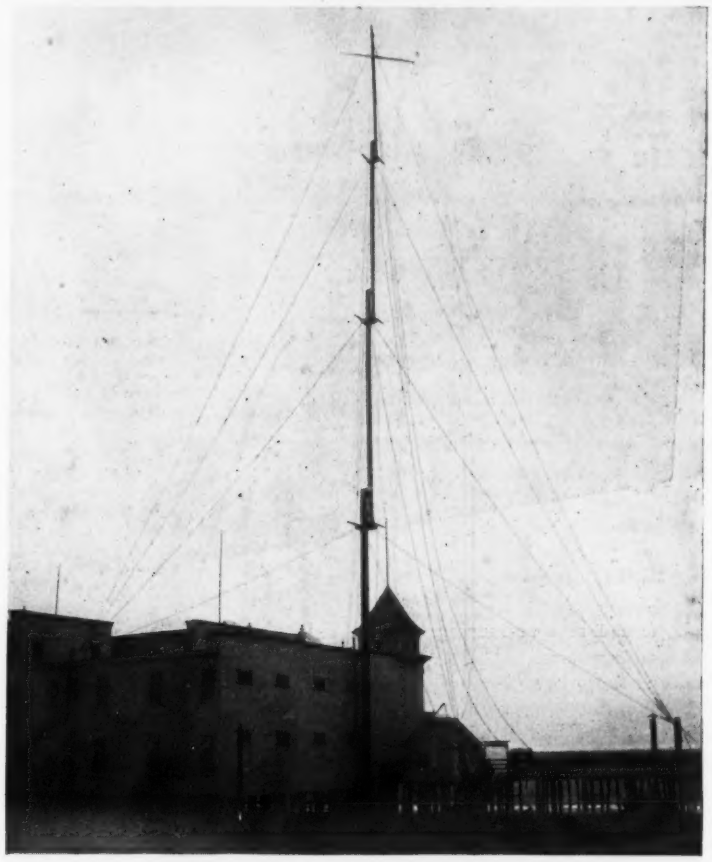


FIG. I.—WIRELESS TELEGRAPH STATION, STATEN ISLAND.

The De Forest transmitter does away with induction coils, all interrupters, and make-and-break devices, as it has been found that a large per cent. of uncertainties and failures in wireless messages is due to the imperfections and irregularities of these devices.

A special key, very like the ordinary Morse key, has been devised with a view especially to high-speed work. The make-and-break is under oil, and the operator is fully protected from contact with high voltage wires. The key also automatically switches the upright conductor, or antenna, from receiver to sender, so that the operator is enabled instantly to "listen in" after sending, and at the same time it is impossible to close the primary circuit while the receiver is connected to the antenna.

By virtue of the automatic quality of the responder it is possible to use a telephone in circuit with the device, and the employment of a relay is rendered unnecessary. By this means a speed of 40 words per minute can be obtained, and under ordinary circumstances a speed of 25 to 30 words is regularly accomplished. One hears in the telephone as it were the sound of the sending spark, be this a high or low frequency, in dots and dashes. An ordinary Morse operator can learn to read with the new apparatus with a few days'

practice. The sending requires no special knack other than a firm touch, with dashes clean cut.

Although, as the accompanying illustration shows, the operator reads from the head telephone, a relay or recording device can be substituted therefor; only there is always this condition, that inasmuch as the responder, unlike the coherer, is a quantitative device, and the telephone and ear the most sensitive signalling device known, at the extreme range messages can be clearly read which are altogether too weak to operate any relay. Thus, through the extreme sensitiveness of the responder an operator with head tele-

FIG. 2.—RECEIVER.

phone can receive messages many miles further than a coherer (all other arrangements at transmitter and receiver being the same), can record them.

As illustration of this, an interesting test may be cited which was made Feb. 22, when signals from the "Etruria" were heard at the Jersey City station, from a mast but 30 feet above the roof, when the steamer was fully 90 miles distant. This was without any "jigger" or transforming device whatever at the receiving end, and represents remarkable sensitiveness in this new "responder."

By virtue of the automatic quality of the receiver, whereby the sound impulses as heard are identical in frequency with that of the transmitter spark, the relay or "call" in use employs a reed attuned to a certain frequency per second. Thus only when the calling station uses a frequency of spark in tune with this reed will the "call" respond and summon the listening operator. This feature thus involving a system for a mechanical or acoustic syntony, in distinction from and in addition to the electrical syntony, is highly significant.

During the last month a regular station and school for operators has been opened by the De Forest Company on the roof of the Chesebrough Building, 17 State Street, New York. Here, as any visitor can see, is a house built of glass over an iron frame, and fully equipped with sending and receiving apparatus. The antenna here is 60 feet in height. The companion station is located at Hotel Castleton, Staten Island, the first hotel in the world, by the way, to be equipped with a wireless plant.

The most important land station yet established by the De Forest Company is that at Steeplechase Park, Coney Island. This enjoys the distinction of having the tallest mast in America, a fine stick of four pieces, standing 210 feet high. This station is supplied with 60-cycle alternating current, at 110 volts, from the street mains. This is stepped-up in two transformers to 25,000 or 50,000 volts, as desired, and applied direct to the spark terminals These latter are of special construction and connected with the condensers give a spark of exceptional clearness and power.

On June 14th, the first day the Coney Island station was operated, the first communication with a vessel equipped with the De Forest system was also established. On the Ward Liner "Morro Castle," bound for Havana, a moderately high (60-ft.) antenna had been rigged, and transmitter and receiver installed. M. F. Stires, secretary of the company, and Mr. Barnhardt, operator, were aboard, and

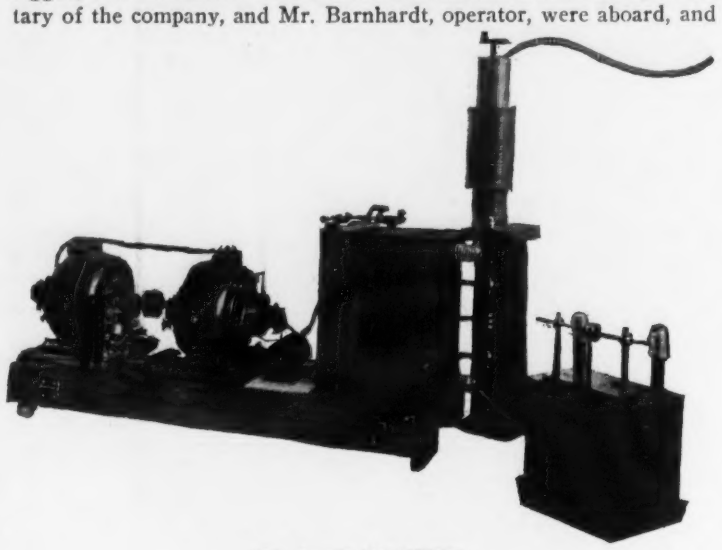


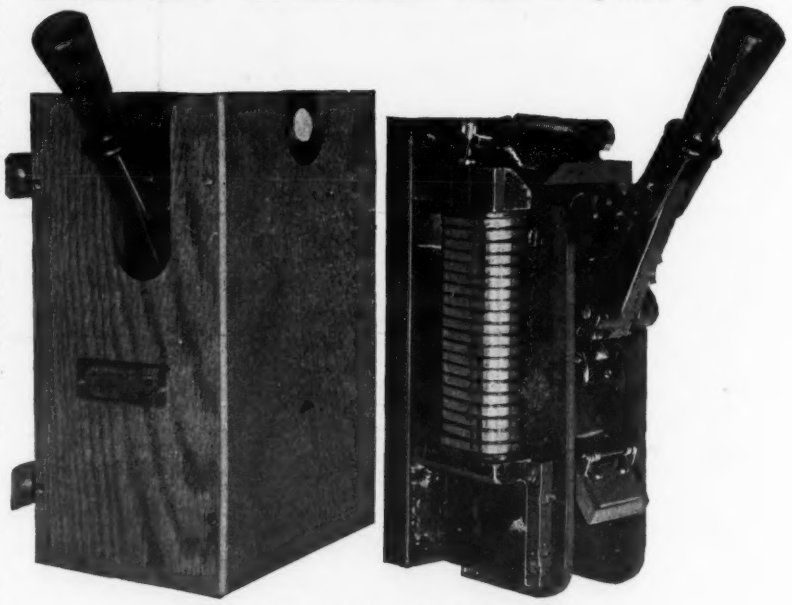
FIG. 3.—TRANSMITTER.

messages to and from ship and shore were exchanged, until the vessel was 50 miles from port.

Previous to this test the Staten Island station had maintained communication with the Hamburg-American liner "Deutschland," on her last trip East, up to a distance of 70 miles. The "Deutschland" was equipped with the Slaby-Arco system, but there was little trouble in inter-communication between the two systems.

Car Circuit-Breaker.

The car circuit-breaker, illustrated herewith, is being placed upon the market by the Cutter Company, of Philadelphia, and represents the latest development in devices of this nature. It has laminated copper contacts and a magnetic blow-out, which breaks the final arc on carbon blocks. This circuit-breaker is made in capacities up to



FIGS. 1 AND 2.—CAR CIRCUIT BREAKER.

450 amperes, and in larger sizes for interurban cars. It is compactly encased in a strong wooden box, the dimensions being 12 inches long, 8⅝ inches wide and 5 inches deep. The instrument is designed to be placed on the hood of the car directly over the head of the motorman. The illustrations show the circuit-breaker with and without the case.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—During the past week, in spite of various conditions that might reasonably be regarded as unfavorable, but not to any extreme degree, the stock market was steady and strong. While good crops now appear to be assured, the bad weather that has so persistentlly hung on all through the summer has done considerable harm, and has hurt many people and industries that depend upon sunshine as an asset in their business affairs. During the week the new stock of the General Electric came on the market, and while the old was quoted at 314-315, the new was quoted at 189-190, which is considered to represent about a parity. Western Union which has been in a fluctuating condition, rallied on dealings in 8,160 shares, and opening at 86 closed at 88½. In the street traction group, Brooklyn Rapid Transit, on sales of 118,000 shares climbed from 67¾ to 72⅛; Manhattan on 100,600 shares rose from 131¾ to 136¼; and Metropolitan Street Railway on 28,800 shares rose from 148 to 150½. In the New York "outside market" New Orleans Street Railway sold at 17, and the new-fangled Manhattan Transit, represented automobile speculation by rising from 6⅞ to 7⅜. One of the subjects of inquiry and doubt has been the effect on the market and on Postal Telegraph and Commercial Cable specifically of Mr. John W. Mackay's death. In London the effect was adverse, but in New York the tendency is to wait and see what happens. Electrical people have also been waiting to see if anything happened in Stanley Electric and Electric Storage Battery, but nothing definite came off apparently last week in the proposed line of consolidation. Below are the closing quotations of July 22:

NEW YORK.

	July 15.	July 22.		July 15.	July 22.
American Tel. & Cable.	—	—	Hudson River Tel.	107	—
American Tel. & Tel.	—	142½	Metropolitan St. Ry.	148¼	150¾
American Dist. Tel.	36	—	N. E. Elec Veh. Trns.	—	—
Brooklyn Rapid Transit	68¾	71¼	N. Y. E. V. T. Co.	12	—
Commercial Cable	160	—	N. Y. & N. J. Tel.	175	—
Electric Boat	25	30	Tel. & Tel. Co. Am.	—	—
Electric Boat pfd.	40	50	Western Union Tel.	86½	88½
Electric Lead Reduc'n.	2⅝	3	West. E. & M. Co.	212	205
Electric Vehicle	6*	6	West. E. M. Co. pfd.	213	213
Electric Vehicle pfd	14½*	14			
General Electric	192	188½			

BOSTON.

	July 15.	July 22.		July 15.	July 22.
American Tel. & Tel.	165	142½	Mexican Telephone	2	2⅜
Cumberland Telephone	—	—	New Eng. Telephone	—	142½
Edison Elec. Illum.	—	—	Westinghouse Elec.	—	—
Erie Telephone	—	—	Westinghouse Elec. pfd.	—	—
Western Tel. & Tel.	—	29½			
Wsetern Tel. & Tel. pfd.	—	102½			

PHILADELPHIA.

	July 15.	July 22.		July 15.	July 22.
American Railways	46	46½	Phila. Traction	99⅛	99⅞
Elec. Storage Battery	95½	93	Phil. Electric	5⅛	5⅝
Elec Storage Bat'y pfd.	94½	—	Pa. Elec. Vehicle	1	—
Elec. Co. of America	6	8¾	Pa. Elec. Vehicle pfd.	3	—

CHICAGO.

	July 15.	July 22.		July 15.	July 22.
Central Union Tel.	—	—	National Carbon pfd.	102	101
Chicago Edison	—	180	Northwest Elev. com.	35⅝	—
Chicago City Ry.	208	210	Union Traction	15	16⅝
Chicago Tel. Co.	—	—	Union Traction pfd	49	—
National Carbon	29¼	29			

*Asked.

NEW ALBANY, IND., CONSOLIDATION.—Under the skillful management of Mr. Samuel Insull, a consolidation has been effected of the entire gas, electric light and heating systems in the city of New Albany, Ind., and the only gas system in Jeffersonville, Ind. The company will also supply the towns of Silver Grove, Port Fulton and Clarksville, lying between the two cities, serving a population in excess of 35,000. There is no competition. The capital stock is $1,000,000, and the net earnings with the four old plants were $41,480. The new United Gas and Electric Company, which will enjoy the services of Mr. Insull as president, has just issued $400,000 first mortgage 5 per cent. bonds out of an authorized $750,000, and the consolidated plants will be extended, economies effected, etc. The company has a street lighting contract for eight years to run and a street railway current contract.

MEMPHIS LIGHTING CONSOLIDATION.—A special telegram from Memphis, Tenn., states that the Billings-Brady syndicate, composed of Anthony N. Brady and C. K. G. Billings, of New York, and other Eastern capitalists, which recently purchased the Memphis Light and Power Company and the Memphis Equitable Gas Light Company for about $2,000,000, has struck a snag in its effort to consolidate the two companies. Secretary of State Morton has refused to grant the application for an amended charter, on the ground that the Equitable Company is chartered under Tennessee laws for the purpose of doing all things permitted gas companies by law and cannot take upon itself the rights of another corporation like an electric light company chartered for a different purpose.

NATIONAL CARBON.—Advices from Chicago say that there are persistent rumors afloat that the General Electric Company is buying into the National Carbon Company, with the view of ultimately controlling that property. General Electric has for a long time been the largest individual holder in the company, and the recent acquisition of both classes of stock have been for these interests. This is conceded by the head of the brokerage house through which the stock has been bought. It is said that whether or not control of the property changes, a dividend on the common stock cannot be far distant.

MICHIGAN BELL TELEPHONE.—The following is a statement of the income account of the Michigan Telephone Company for year ended Dec. 31, 1901: It will be noted that for the year ended Dec. 31, 1901, there was a deficit after expenses and interest payments of $292,368. The balance sheet shows a floating debt of above $2,500 and a profit and loss deficit of $487,115. Year ended Dec. 31, 1901: Gross receipts, $1,328,681; expenses, $1,180,914; net, $147,767; interest, $440,135; deficit, $292,368. The company recently defaulted on its bonds.

ST. LAWRENCE POWER.—The St. Lawrence River Power Company, of Massena, St. Lawrence County, has been incorporated with a capital of $7,000,000. The directors are Henry P. Davison, of Englewood, N. J.; Mark T. Cox, East Orange, N. J.; Samuel E. Potter, William J. Wilson, New York, and Thomas A. Gillespie, Massena. This company will, it is presumed, take over the Massena enterprise.

HUDSON RIVER POWER.—A certificate has been filed in the Saratoga County Clerk's office increasing the capital stock of the Hudson River Electric Company, owning the mammoth new concrete dam at Spiers Falls, from $1,000,000 to $3,000,000. The company expects to begin transmitting power to the General Electric Company's plant, at Schenectady, on Sept. 1.

DIVIDENDS.—The directors of Chicago Edison Company have declared the regular 2 per cent. quarterly dividend, payable August 1st. The Minneapolis General Electric Company has declared a regular semi-annual dividend of $3 on preferred stock, payable to stockholders of record July 22.

MACON CONSOLIDATION.—The Macon (Ga.) Consolidated Street Railroad and the Macon Electric Light and Railway Company are to be consolidated and operated under the direction of the Railways and Light Company of America.

Commercial Intelligence.

THE WEEK IN TRADE.—Weather, crop and industrial developments have been largely favorable, and coupled with the greater ease of money make for an optimistic feeling in trade and speculation, says *Bradstreet's*. Railway earnings continue satisfactory, June returns of nearly 100,000 miles of road showing an aggregate gain of 8 per cent. over last year. In the matter of actual business, improvement is noted in the demand for finished products of iron and steel, and lumber seems to be recovering from the temporary depression noted at the beginning of this month. Iron and steel trade conditions seem surprisingly good, heavy sales of finished material being reported from Chicago and Pittsburg. Special activity is noted in bar iron, structural material, rails, and, in fact, all of the heavier forms. The industrial situation has improved considerably, many strikes having been settled. The business failures for the week aggregated 174 as against 195 the week previous and 208 the same week last year. The copper market is quiet, buyers showing some interest at the lower prices. The quotations are 11⅞ @ 12c. for Lake, 11¾ @ 11⅞ for electrolytic in cakes, wire bars and ingots, and 11½ @ 11⅝c. in cathodes.

MIDDLETOWN, N. Y.—The Orange County Gas and Electric Light Company has passed into the control of the Henry Floy Company of New York. The new officers are: Henry Floy, president; M. C. Kimball, vice-president; L. L. Lewis, secretary, and C. Fitzgerald, treasurer. The company has a contract with the Neversink Light & Power Company for the construction of a power plant near Cudebackville, work on which is now progressing. From this plant, which will have a capacity of 1,000-hp, electrical energy will be transmitted to Port Jervis and Monticello for lighting and power purposes.

ORDERS FOR SPRAGUE APPARATUS.—The Sprague Electric Company has been securing many important contracts for its motors and generators, and both its Watsessing factory and New York conduit factory are rushed to the utmost. In addition to its foreign orders and many orders for small size apparatus, it has recently made the following sales: Atlas Portland Cement Company, Hannibal, Mo., seven 35-hp motors and eight 15-hp motors; Atlas Portland Cement Company, Northampton, Pa., one 30-hp motor and two 35-hp motors; E. W. Bliss, New York City, fifteen 10-hp motors, seventeen 25-hp motors and one 50-hp motor; Lehigh Portland Cement Company, Wellston, O., one 300-kw bolted generator, one 230-hp motor and six smaller motors aggregating 100-hp; Emery Bird Thayer Dry Goods Co., Kansas City, three split pole engine type generators, 60-kw, 100-kw and 350-kw, respectively; Mergenthaler Linotype Company, Brooklyn, one 150-kw split pole engine type generator; Government Printing Office, Washington, D. C., contract for ventilating plant consisting of direct connected American Blowers and the following motors, one 5-hp motor and one 10-hp motor, two 15-hp motors and eight 20-hp motors; Chas. Scribner and Son, New York City, seven motors of 3 and 4-hp; American Sugar Refining Company, Brooklyn, six 20-hp motors; Hatzel & Buehler, New York City, one 125-hp motor for New York *Herald;* The Alliance Press, New York City, nine motors for printing presses; Lackawanna Steel Co., West Seneca, N. Y., one 3-ton trolley hoist; The John Simmons Company, New York City, one 50-kw bolted generator and two motors, 20 and 25-hp respectively; Shoreham Hotel, Washington, D. C., three split-pole engine type generators to develop 50, 75 and 100-kw respectively; Baltic Mills Company, Baltic, Conn., one 75-kw split pole belted type generator; Gorham Mfg. Co., Providence, R. I., one 40-hp motor; Utica Steam and Mohawk Valley Cotton Mills, Utica, N. Y., two 100-kw split pole belted generators; Duluth Printing and Pub. Company, Duluth Minn., one 25-hp motor; Gray Lithograph Co., New York City, three motors, two 5-hp and one 20-hp; New York Life Insurance Company, New York City, two 50-kw split pole belted generators; Arthur Frantzen Company, Chicago, one 5-hp and two 20-hp motors; James Wilson, Pittsfield, Mass., one 150-kw belted generator and two motors, 20 and 25-hp, respectively; 50-hp motor and one 15-hp motor; Pennsylvania Steel Company, Steelton, Pa., ten 5-ton trolley hoists; Sigourney Tool Company, Hartford, Conn., one 75-kw split pole engine type generator; Lindell Hotel Company, St. Louis, one 60-kw and one 75-kw split pole belted type generator; Treasury Department, Bureau Engraving and Printing, Washington, D. C., one 20-hp motor; American Can Co., New York City, one 75-kw engine type generator and one 35-kw belted generator; Lewis Institute, Chicago, one 75-kw split pole engine type generator; George A. Fuller Co., New York, for the ventilating system in R. H. Macy's new store, four 25-hp motors and one 10-hp motor. Miller, Tompkins & Co., New York City, one 15-hp motor; Hibbard-Rodman-Ely Safe Co., Plainfield, New Jersey, two 25-hp motors; Goes Lithograph Co., Chicago, 20 motors, various sizes; Chas. Schweinler, New York, fifteen 5-hp motors; Tucker Elec. Construction Co., for The National Meter Company, Brooklyn, N. Y., one 75-kw split pole engine type generator.

ALLIS-CHALMERS ENGINE ORDERS.—During the month of June, the Allis-Chalmers Engine Company, of Milwaukee, made the following sales of large engines, all of the Reynolds-Corliss type, and either of the 1890 frame or the girder frame: W. F. Stewart Co., Flint, Mich., 18 in. x 36 in.; Russel, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y., 22 in. x 48 in.; Brown, Cary & Woodruff Co., Salt Lake City, Utah, 12 in. x 36 in.; Tyee Copper Co., Ladysmith, Vancouver Island, 14 in. x 36 in.; Kioto Traction Co., Kioto, Japan, 16 in. and 32 in. x 36 in., cross compound direct coupled; P. A. Peterson, Rockford, Ill., 10 in. x 30 in.; Park City Sampling Mills, Park City, Utah, 16 in. x 36 in.; Hudson River Lumber Co., Kansas City, Mo., 20 in. x 42 in.; International Paper Co., New York City, N. Y., 16 in. x 42 in.; Virginia Carolina Chemical Co., Richmond, Va., one 16 in. x 42 in., one 20 in. x 42 in.; Janesville Cement Post Co., Janesville, Wis., 14 in. x 36 in.; Geo. T. Houston, Chicago, Ill., 28 in. x 48 in.; Twin City Rapid Transit Co., Minneapolis, Minn., 46 in. and 94 in. x 60 in., vertical cross compound direct coupled (third order); West Allis Malleable Iron and Chain Belt Co., West Allis, Wis., 12 in. x 30 in.; John Q. Gantz, Elon College, N. C., 18 in. x 48 in.; London United Tramways, London, Eng., 26 in. and 54 in. x 48 in. vertical cross compound direct coupled.

PRODUCTION OF MICA.—According to a bulletin of the U. S. Geological Survey, issued by Director C. D. Walcott, the total amount of plate mica produced in the United States during 1901, as reported to the Survey, was 360,000 pounds, valued at $98,859, as compared with 456,283 pounds, valued at $92,758, in 1900. There was a large falling off in the amount of scrap mica produced in 1901, estimated at 2,165 short tons, valued at $19,719, as compared with 5,497 tons, valued at $55,502, in 1900. The importation of mica from Canada and India tends to curtail the production in the United States, especially the Indian mica, which can be imported at a cost lower than that for which it can be mined in this country. There was an increase in the production of plate mica in North Carolina, but a large falling off in the production of scrap mica. The imports of mica in 1901 were valued at $335,054, as compared with $319,560 in 1900, and with $275,984 in 1899. The use of mica in sheets for stove, chimneys, etc., has increased greatly, but still more the use of small circular disks and rectangular pieces of mica for insulation purposes and for electrical apparatus. Ground scrap mica is used in the manufacture of wall papers, lubricants, etc. Scrap mica, also, arranged on a wire net coil, and then pressed into proper shape, is used very satisfactorily as a boiler tube covering, mica being a non-conductor of heat.

THE PELTON WATER WHEEL COMPANY, of San Francisco and New York, report an unusually large number of both foreign and domestic orders for the last month, notably water-wheel plans for the Clark Electric Company, of Ophir, Utah, which will require 2,000-hp for driving its generators, which will generate power for the mines and towns about Tooele county, Utah. The Pacific Portland Cement Company, of Spokane, Wash., is about to install Pelton wheels to operate its entire plant. A foreign order of unusual interest, from its inaccessibility and magnitude, and competition from all the manufacturers of Europe, has just been received from the Spanish Cement Mills, near Barcelona, Spain. This order calls for several miles of heavy sheet, steel-riveted pipe, and water wheels to generate power for their entire plant, which is one of the largest of its kind in the world. Among other orders might be mentioned those from the Salvador Mining Company, Rix Compressed Air & Drill Company, Ledge Mining & Milling Company, Lahaina Plantation Company, Ouray Electric Light & Power Company, and the Ardjassarie Electric Power Transmission Company, of Batavia, Java.

EQUIPMENT FOR WESTERN GLASS WORKS.—The Great Western Glass Company, of Ottawa, Ill., has just placed a substantial contract for equipment to be used for lighting and power transmission in its new glass works. The contract calls for a 75-kw generator, direct connected to a 12 in. x 12 in. engine and a 50-kw generator direct connected to a 11 in. x 10 in. engine. The generators will be built by the C. & C. Electric Company. The engines will be of horizontal type and are to be furnished by the Ames Iron Works of Oswego, N. Y. There will also be 11 C. & C. motors varying in size from 2-hp to 35-hp; a large three panel switchboard; 50 arc lamps and 500 incandescent lamps.

SIX-HUNDRED H.-P. HORIZONTAL GAS ENGINE PLANT.—The Consolidated Industries Company of New Jersey, which concern owns the electric light and power plant at Batavia, N. Y., has placed a contract with Westinghouse, Church, Kerr & Company for a 600-hp gas engine plant, to operate the entire machinery in the station. The equipment, which will consist of two horizontal, double-acting, tandem type engines of 250-hp, each of recent design by the Westinghouse Machine Company, and one 80-hp; also a 20-hp one, will be the first plant of horizontal gas engines of any importance in the country.

HAVANA PLANT TO BE EXTENDED.—The Spanish-American Light and Power Company, to which some reference was made in these columns recently, and of which T. J. Hayward, of Bartlett, Hayward & Co., Baltimore, Md., and 100 Broadway, New York, is the president, is about to extend its Havana electric lighting plant. The new equipment will consist of three 600 k.w. generators. The contract will be let direct from Havana. Mr. E. Zorilla is general manager of the company. Mr. Charles Woodriffe is the chief engineer, and Mr. R. Jimenez is the engineer of the electric plant.

EQUIPMENT FOR ST. LOUIS RAILWAY PLANT.—The East St. Louis (Mo.) Suburban Railway Company, which has acquired the franchises formerly held by the St. Louis, Belleville and Suburban Railway Company, is placing contracts, through Lichter & Jens, Chemical Building, St. Louis, for various equipment to be installed in its new plant at East St. Louis. The latter company's plant is being removed from St. Louis proper to East St. Louis, and considerable additions are to be made thereto. John A. Mead & Company will furnish some coal and ash handling machinery.

STORAGE BATTERY PLANT FOR OTTAWA.—The Ottawa Electric Street Railway Company, Ottawa, Ont., will install a storage battery plant adjacent to its powerhouse at Chaudiere Falls. The battery will take care of the "peak" of the load on the station. It has been purchased of the Electric Storage Battery Company, of Philadelphia, and, it is stated, cost $75,000.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from for the week ended July 19: Antwerp—3 pkgs. machinery, $257; 7 Republic—4 pkgs. machinery, $683; 36 pkgs. material, $1,693. Antwerp—2 pkgs. machinery, $150; 12 pkgs. material, $768. Azores—2 pkgs. material, $36. British Australia—20 pkgs. material, $170; 2 pkgs. machinery, $87. Brazil—13 pkgs. material, $739; machinery, $165. Brazil—206 pkgs. material, $6,825; 155 pkgs. machinery, $10,433. Bremen—3 pkgs. material, $53. Baku—1 pkgs. material. $200. British Guiana—9 pkgs. material, $440. dies—5 pkgs. material, $96. Constantinople—2 pkgs. machinery, $59. Central America—28 pkgs. material; $447; 1 pkg. machinery, $100. Cuba—10 pkgs. material, $223. Christiania—3 pkgs. material, $1,355. Central America—36 pkgs. material, $424. West Indies—7 pkgs. material, $87. Dutch East Indies—13 pkgs. material, $228. Egypt—6 pkgs. material, $500. Ecuador—4 pkgs. material, $81. Glasgow—11 pkgs. material, $699; 31 pkgs. machinery, $1,575. Genoa—31 pkgs. material, $275. Havre—11 pkgs. machinery, $1,660; 12 pkgs. material, $242. Hamburg—5 pkgs. machinery, $3,266; 29 pkgs. material, $1,156. Liverpool—367 pkgs. machinery, $23,308; 951 pkgs. material, $6,530. London—92 pkgs. machinery, $1,492; 102 pkgs. material, $7,666. Manchester—496 pkgs. machinery, $46,980; 1 pkg. material, $92. Mexico—199 pkgs. material, $3,315; 31 pkgs. machinery, $915. New Zealand—1 pkg. machinery, $97; 34 pkgs. material, $2,153. Portsmouth—3 pkgs. material, $300. Peru—10 pkgs. machinery, $450; 13 pkgs. material, $365. Rostoff—3 pkgs. machinery, $162. Southampton—1 pkg. material, $17; 1 pkg. machinery, $135. U. S. Colombia—8 pkgs. material, $207. Vienna—4 pkg.s machinery, $220. Venezuela—2 pkgs. material, $16.

WESTINGHOUSE, CHURCH, KERR & COMPANY during the last month have received a large number of orders for Westinghouse steam engines and turbines, including two of the largest engines in existence for power service. The New York Edison Company have ordered two more 6,000-hp vertical 3-cylinder compound engines in addition to the eight of this same type now running and under course of erection at their Waterside station. The Rapid Transit Subway Construction Company, New York, has just placed an order for three 1,250-kw turbo-generator sets for installation in their new power house, and also two 400-hp Westinghouse vertical marine type cross compound engines. The turbines will be used for lighting the power station and subway and stations, and the compound engines, which are built to run on high-pressure, superheated steam, direct connected to Westinghouse generators, will be used as the main exciter units for the power station.

NITROGEN FROM THE AIR.—The Atmospheric Products Company of Niagara Falls have broken ground for their first building on the lands of the Niagara Falls Power Company, to be the construction plant for the apparatus to be used by the company in equipping their contemplated large factory adjacent. Within a short time the Atmospheric Products Company will start their second building, which will be the first factory in the world in which products are to be manufactured from air as the raw material, the company having accomplished the fixation of nitrogen. This second building will be 500 feet long and 50 feet wide. Mr. C. S. Bradley has been spending considerable time at Niagara on this work, whose success was shown experimentally to Lord Kelvin while he was here in May.

TOSSIL CREEK POWER PLANT.—The Arizona Construction Co., which lately incorporated at Prescott, Ariz., is starting one of the largest enterprises ever attempted in the southwest. This company will build a large power generating plant on Tossil Creek, and transmit power to Prescott, Jerome, Big Burg, Lynx Creek, Groom Creek and the many adjacent mines. Several large sub-stations will be located at the centers of the various mining districts. Tossil Creek is about 52 miles from Prescott. This will be the first long-distance transmission plant in Arizona, except the 25-mile line at the Phœnix Light and Power Co. and will be the beginning of a series of like developments. Mrs. I. E. Tutt, the manager, has plans for several more, ranging in size from 2,500 to 1,200-hp.

BELL TELEPHONE OUTPUT.—The instrument statement of American Telephone and Telegraph for the month of June and also since Dec. 20 shows as follows:

June:	1902.	1901.	1900.
Gross output	96,653	96,300	55,613
Returned	41,741	34,221	25,671
Net output	54,912	62,079	29,942
Since Dec. 20, 1902:			
Gross output	589,109	469,923	346,146
Returned	226,267	194,569	132,660
Net output	362,842	275,354	213,486
Total outstanding	2,888,854	2,228,170	1,793,991

LIGHTING PLANT FOR JAPAN.—The Japanese house of Takata & Company, 10 Wall street, has just placed a contract for one of the smallest complete electric lighting plants ever installed in the Far East. The outfit, which is intended to be utilized in the Osaka Club Hotel, Japan, will consist of a 17½ k.w., 125 volt, Westinghouse engine type generator, direct connected to a 7½x17 inch Westinghouse standard automatic engine, 390 r. p. m.; a special duplex feed pump 3x2x3 inches, to be furnished by the Knowles end of the International Pump Company; a Wainwright vertical pattern overflow heater; a Babcock & Wilcox water tube boiler, etc.

ONONDAGA DYNAMOS IN SEWAGE PLANT.—An interesting sewage disposal plant, with a capacity of 2,000,000 gallons of sewage per day, located near Bergen's Landing, on Jamaica Bay, Long Island, is about ready to go into operation. The plant, which is said to be the largest ever constructed on this system of precipitation, will be operated and lighted by electricity, furnished by a 50-hp Onondaga generator, made by the Onondaga Dynamo Company, Syracuse, N.Y. The generator will be belted to a 60-hp Westinghouse "Junior" engine. The Onondaga Dynamo Company will also supply the 10 motors which are being installed throughout the plant.

MAGNETIC SEPARATOR PLANT.—One of the oldest magnetic ore separating plants is increasing its equipment, namely that of Witherbee, Sherman & Co. at Port Henry, N. Y. They are installing a large central power plant for which the General Electric Company is furnishing the generators. There are to be three separating plants requiring current, with four new electric hoists, and an air compressor plant driven by electricity.

THE STANDARD STEEL CAR COMPANY is equipping its new plant for electric driving throughout. A recent purchase from the Westinghouse Electric & Mfg. Co. comprises two 375-kw, A. C. generators, one 400-kw, D. C. generator, and a 300-kw rotary converter for use as a connecting link between the two. This company has, also, purchased about fifty induction motors which will be used largely for direct connection to machine tools.

BALL ENGINE PLANTS.—The West Virginia Reform School at Fetterman, W. Va., is installing an electric plant. The engine will be furnished by the Ball Engine Co., Erie, Pa., and the generator by the Westinghouse Elec. & Mfg. Co. Sanger Bros.' dry goods house at Waco, Texas. will have their own electric plant, the engines being furnished by the Ball Engine Co.

ELECTRICITY IN STEEL MILLS.—Jones & Laughlins, of Pittsburg, Pa., are continually making additions to their electrical equipment and have just recently ordered from the Westinghouse Electric & Mfg. Co. one 800-kw D. C. generator, two 150-kw, motor-driven, two-phase alternators, and two 125-light, motor-driven arc generators.

CONTRACT FOR SWITCHBOARD.—The contract for building a new 9-panel high potential, alternating switchboard at the plant of the Fitchburg Gas and Electric Co., Fitchburg, Mass., has been secured by S. B. Condit, Jr. & Co., Boston. This board will be equipped with the Elden remote-control oil circuit breakers, made by this firm.

TELEPHONE EQUIPMENT.—Mr. J. D. Morris of Roxboro, N. C., is interested in a telephone enterprise to be incorporated to establish an exchange in that town and vicinity. The exchange will have a capacity of about 50 subscribers. Mr. Morris would like prices for construction material and outfit of instruments.

MESSRS. S. C. FARNHAM, BOYD & CO., LTD, engineers and ship builders, of Shanghai, China, having added an electrical department to their business, would be much obliged for catalogues and terms from manufacturers of and dealers in electrical supplies and accessories of every description.

MR. G. M. GEST, the well known conduit contractor, has just received through his Cincinnati office the contract for the underground work of the Bell Telephone Company of Cincinnati. This will amount to nearly one hundred thousand duct feet.

A RIDGWAY PLANT.—McClave, Hamilton & Co., New York City, have been awarded the contract for the new electric plant in the department store of A. D. Mathews & Sons, Brooklyn. Ridgway dynamos and engines will be installed.

THE CARBORUNDUM COMPANY at Niagara Falls, N. Y., are enlarging their plant and putting up a new three-story brick building 50 x 225 feet. The production of carborundum in 1901 was nearly 4,000,000 pounds.

JACOB MILLER, SONS & CO., of Philadelphia, have recently purchased, through their engineer, Dr. W. A. Drysdale, a 180-kw Westinghouse, 2-phase, belted alternator, complete with direct-connected exciter.

General News.

THE TELEPHONE.

PUEBLO, COL.—The Colorado Telephone Company will install an entire underground system in Pueblo.

BLUE RIDGE, GA.—The Blue Ridge Telephone Company, of which John H. Carter is president, is now in active working order. About 60 telephones have already been put in here, five or ten at Mineral Bluff, several at McCays, Tenn., and about 15 at Morganton. Besides these about 25 or 30 more have been ordered.

CHICAGO, ILL.—The Chicago Telephone Company will spend $16,000 on a telephone exchange building at Chicago Heights. It will be two-story, 24 by 75 feet. The same company has begun the construction of an exchange building at Laflin and Nineteenth Streets, the cost to be $30,000.

INDIANAPOLIS, IND.—The Knox County Home Telephone Company has incorporated with a capital of $125,000.

SOUTH RAUB, IND.—The South Raub Co-operative Telephone Company has been incorporated with a capital stock of $4,000.

INDIANAPOLIS, IND.—The New Telephone Company has opened its new branch station for the south side. The switchboard has a capacity of 1,800 lines.

SYRIA, IND.—The Syria & Orleans Telephone Company, capital stock $540, has been incorporated. Directors: A. J. Pickens, Jas. L. Nebbitt, H. McCoy and others.

INDIANAPOLIS, IND.—The Akron Telephone Company has incorporated with a capital stock of $5,000. Andrew A. Gust is president and C. T. Howe is secretary.

BRICK CHAPEL, IND.—The Brick Chapel Telephone Company has been incorporated to establish and operate a telephone system in Putnam County. J. M. Allen, R. A. Tulboll and J. M. Jones constitute the board of directors.

INDIANAPOLIS, IND.—The Whiteland Telephone Company, of Whiteland, has increased its capital stock to the amount of $10,000; and the Eastern Indiana Telephone Company, of Winchester, has increased its capital from $5,000 to $15,000.

PIERCETON, IND.—The Pierceton Telephone Company, of Pierceton, has been incorporated. Capital stock, $20,000. The corporation proposes to establish telephone systems in Kosciusko, Whitley, Noble, and Wabash Counties. J. T. Brosnahan, D. W. Strause and Harry Humrichouser, are the incorporators.

INDIANAPOLIS, IND.—At a conference here on July 5 between President Sherrin of the New Long Distance Telephone Company, of Indianapolis, G. H. Hendren and J. F. Slickard, of Bloomfield, D. A. Yoder, of Vicennes, J. H. Klinger and M. J. Murphy, of Brazil, Guy Bush, of Clay City, and C. P. East, of Worthington, contracts were signed connecting large territory with the New Telephone Company's system. Most of these independent lines will connect with the long distance system at Spencer.

DENISON, IOWA.—The Crawford County Telephone Company has been incorporated with J. B. Romans, president, and J. F. Glenn, secretary.

DEXTER, IA.—The Dexter Mutual Telephone Company, capital $5,000, has been incorporated by W. W. Brown, S. F. Lenacker, E. B. Yaple and J. M. Goodson.

SIOUX CITY, IA.—The Sioux Valley Telephone Company of Cherokee has given notice to the Secretary of State of an intention to issue $25,000 of preferred stock in addition to the same amount of common stock.

DES MOINES, IA.—The Iowa City and West Branch Mutual Telephone Company, Scott township, Johnson County, has been incorporated. Capital, $2,000. President, J. T. Struble; vice-president, Geo. Hunter; secretary, J. J. Murphy; treasurer, James Douglas.

PORTLAND, ME.—The New England Telephone & Telegraph Company has added a new section to its switch-board at Belfast to accommodate the toll business, which calls for an increase of the office force to five persons. New direct lines to Bangor and Portland have recently been put in.

ANGUSTA, ME.—The Stone Telegraph & Telephone Company with a capitalization of $10,000,000, has filed a certificate at the office of the Secretary of State. The company was organized at Portland. The promoters are Alexander Porter Browne and Brainerd Judkins, of Boston; John Stone, of Cambridge; and John W. Anderson, A. G. Berry, M. Warren and Wm. M. Bradley, of Portland.

THREE RIVERS, MICH.—The Three Rivers Telephone Company has increased its capital stock from $10,000 to $25,000.

MENOMINEE, MICH.—The Wisconsin Telephone Company will expend about $8,000 on improvements and reconstruction of the line at Sturgeon Bay, New and larger cables are to be put in and old poles reset and fixed and the line extended to the outskirts of the city.

PONY, MONT.—The Citizens' Telephone Company, of Pony, has been incorporated. Capital, $3,000. H. Z. Schreiner, Blazet Tinsley and others are the incorporators.

JEFFERSON CITY, MO.—The state board of equalization July 15 passed a resolution directed to the telephone companies in the State, ordering them to report to the board at once the amount of certain kinds of property owned by them, in order that the property may be assessed for State taxes.

JERSEY CITY, N. J.—At the recent annual meeting of the American Union Telegraph Company of New Jersey these directors were elected: R. C. Clowry, T. F. Clarke, B. Brooks, A. R. Brewer and J. B. Bertholf. The directors elected the following officers: R. C. Clowry, president; T. F. Clarke, vice-president, and A. R. Brewer, secretary and treasurer.

ITHACA, N. Y.—The Lyons Telephone Company and the Wayne County Telephone Company have been consolidated.

ALBANY, N. Y.—The Crosby and Barrington Telephone Company of Yates County has been incorporated. Capital $5,000, and directors: C. E. Guile and H. S. Fullager, of Penn Yan, and A. P. Mortimer, of Dundee.

TROY, N. Y.—The Hudson River Telephone Company has sold its Pennsylvania lines to the Pennsylvania Telephone Company, of Harrisburg, Penn. It is understood the price was $10,000. The franchises are located in Wayne and Pike Counties.

URBANA, OHIO.—The Urbana Telephone Company has increased its capital stock from $50,000 to $100,000.

HARRISON, OHIO.—The New Baltimore & Venice Telephone & Telegraph Company has secured a franchise in Harrison.

WAPAKONETA, OHIO.—The Wapakoneta Telephone Company has increased its capital stock from $25,000 to $40,000. About 500 subscribers are now served by the company.

COLUMBUS, OHIO.—The East Springfield Telephone Company, East Springfield, Jefferson County, has been incorporated with a capital of $6,000 by H. L. Fiscus and others.

FINDLAY, OHIO.—The People's Telephone Company has been incorporated with $25,000 with J. M. Crawford, Columbus Grove, president; Milton May, Mt. Blanchard, secretary-treasurer; Nora Samson, manager. The headquarters are at Mt. Blanchard and the company is operating exchanges at Mt. Blanchard, Arlington, Forest, Martin and Jenera.

OTTAWA, ONT.—The Canadian Machine Telephone Company has been incorporated by Hon. G. E. Foster, M. P. Ludwig and J. A. Phin, of Toronto, and J. E. Ganong and J. D. Chapman, of St. Stephens, N. B. The capital is $250,000 and the headquarters will be in this city.

OTTAWA, ONT.—The mayor of Ottawa, Ont., has received from the Elektrisk bureau, Christiana, Norway, a tender for the establishment of a telephone system in Ottawa with a minimum of 2,500 and a maximum of 5,000 subscribers. The tender is merely for the apparatus and central. The figures are withheld for the present by the civic authorities in view of the uncertainty of the telephone situation of the city.

AUSTIN, TEX.—The North Texas Telephone Company of Pecan Gap, Delta County; capital stock $5,000 has been incorporated by W. A. Cockrell, W. R. James and J. H. Sardin.

SALT LAKE CITY, UTAH.—The Colorado Telephone Company will extend its lines from Cripple Creek to Salida, taking in the towns of Whitehorn, Turet and other intermediate mining camps.

SALT LAKE CITY, UTAH.—The Sunset Telephone Company has bought out the local telephone company operating in the El Cajou section, Calif. New lines will take in Lakeside, Dehesa, Jacumba, Santeé, Descano, La Mesa. Alpine and a few small towns.

PRAIRIE DU CHIEN, WIS.—The Union Telephone Company, of Prairie du Chien, has increased its capital stock from $1,000 to $5,000 and the number of directors from five to three.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Edison Electric Company, of Los Angeles, Calif., has completed the sale of bonds to the amount of $10,00,000, the proceeds of which will be devoted to completing its great electric power system. The plans which were completed some months ago, include the transmission of electric power from power stations to be installed along the Kern River, to Los Angeles; duplicate power lines for the transmission of current from Kern County to Los Angeles and other cities, and auxiliary steam power generating stations.

DENVER, COL.—The branch power house of the Denver Gas & Electric Company, at Montclair, was entirely destroyed by fire on June 27.

HARTFORD CITY, IND.—The National Rolling Mill Company is to put in a new electric light and power plant.

CALUMET, MICH.—The electric plant at the Baltic Mining Company, Houghton County, Lake Superior, Mich., went in commission July 12. This is one of the plants installed by Frederick N. Bosson, Consulting Engineer, and who is the electrical engineer for the Calumet and Hecla Mining Company at Calumet.

BUTTE, MONT.—An ordinance will be introduced in the city council to require all overhead wires to be placed underground.

HELENA, MONT.—In the organization of the Helena Power & Light Company, which was sold under order of the United States Court recently, the corporation is to take the name Helena Light & Traction Company. The capital of the new company will be $100,000. The directors are Thomas A. Marlow, Henry M. Parchen, Albert L. Smith and Norman B. Holter, of Helena and Kenneth Clark, of St. Louis, Mo.

RATON, N. M.—The present capacity of the electric light plant is 3,000 lights and it will be increased to 5,000. A 200-hp engine will be added and a new building will be erected. The cost of the improvements will be about $25,000.

ALBANY, N. Y.—The West Seneca Light, Heat and Power Company, of West Seneca, has been incorporated; capital, $200,000. Directors: E. B. Smith, C. A. Hahl, H. N. Kraft, Buffalo.

WEST SENECA, N. Y.—The West Seneca Light, Heat & Power Company has been formed under the laws of New York with a capital stock of $200,000. The directors are E. B. Smith, C. A. Hahl and H. N. Kraft.

CLEVELAND, OHIO.—The Cleveland Pneumatic Tool Company, H. W. Cole, secretary and treasurer, is to erect and equip a new plant driven electrically.

BATAVIA, OHIO.—The village of New Richmond has issued $4,000 worth of bonds for the purpose of increasing the capacity of its lighting plant.

COLUMBUS, OHIO.—The East Columbus Heating & Electric Lighting Company has been granted a 25-year franchise. Current will be furnished at 15 cents per kilowatt with a graduated rate of discount.

EATON, OHIO.—The council is taking preliminary steps to secure a municipal lighting plant. The contract with the present company expires in a few months. The question will be submitted to popular vote.

MASSILLON, OHIO.—G. A. Myers, of Massillon, who has secured the franchise for illuminating the town of Navarre, announces that work of building the plant will start at once. A 40-kw generator, an 80-hp engine and an 80-hp boiler will be required.

BOWLING GREEN, OHIO.—The Citizens' Light, Heat and Power Company of this city has consolidated with the Lake Erie, Bowling Green and Napoleon Electric Railway. A new company will be organized under a new name.

BAKER CITY, ORE.—F. S. Baillie, H. S. Bowen and J. L. Rand, as incorporators of the Consolidated Power Company, of Baker City, have filed incorporation papers. Capital stock, $100,000.

BAKER CITY, ORE.—The installation of two electric plants at Baker City will be accompanied by the irrigation of a large area of land near that city, it being proposed to use electric power to operate large pumps to supply the water.

DOYLESTOWN, PA.—The Doylestown Electric Company, of Doylestown, Pa., has recently contracted with the Westinghouse Electric & Manufacturing Company for two 100-kw, engine-type, two-phase alternators with direct-connected exciters, complete with switchboard. The engineer for the work is Dr. W. A. Drysdale, of Philadelphia.

DENISON, TEX.—The "Katy" railway company will build a large electric light plant in connection with other improvements at Denison.

SALT LAKE CITY, UTAH.—The Adder mining property at Silver City, Idaho, will install an electric light and power plant.

MERCUR, UTAH.—The recent fire here totally wrecked the new sub-station lately erected by the Telluride Power Company. The loss is $8,000.

SALT LAKE CITY, UTAH.—There is talk of utilizing Owens River, in Nevada, for generating electric power for transmission to Tonopah, Nev., for operating mine and mill machinery. The point where the plant is to be built is 100 miles from Winnemucca, and here 10,000 hp can be generated at all seasons.

NEWPORT NEWS, VA.—Work has been begun on the large electric power house to be erected in Phoebus by Mr. W. S. P. Shields, of Philadelphia. It will cost about $150,000.

DAVENPORT, WASH.—C. O. Green, of Ritzville, Wash., has applied to the city council here for a franchise for the Davenport Electric and Power Company.

SPOKANE, WASH.—The city council of Spokane will make a deal with a new corporation for utilizing the waste water power at the up-river station. A power plant will be erected to supply the city with electric lights.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The North Shore Railroad Company has specifications out for the equipment for its 2,000 hp electric generating station that is to be constructed at Corte Madera, between Sausalito and San Rafael, Calif. The plant will be operated by steam power. A large proportion of the electric power used on the electric division of the railroad will be supplied from the Bay Counties Power Company's transmission lines. At least one unit of the steam plant will always be kept in operation, however, to prevent interruption of the service in case of accident to the transmission system. The estimated cost of the power plant is $225,000.

CHICAGO, ILL.—The Ridgeland power house of the Consolidated Traction Company, at Ridgeland Avenue and Lake Street, was partly destroyed by fire recently at a loss estimated at $125,000.

WARSAW, IND.—The Winona, Warsaw, Elkhart & South Bend Traction Company has been incorporated with a capital of $400,000. S. P. George is president; S. A. Collins, secretary.

PRINCETON, IND.—The Jasper, French Lick, West Baden and Northwestern Traction Company has been organized with a capital stock of $100,000, which will be increased to $500,000.

LEAVENSWORTH, IND.—The Leavensworth Electric Railway Company has been incorporated. The capital stock is $100,000. T. P. Elsworth, S. A. Beale and O. E. Hawn are directors.

INDIANAPOLIS, IND.—The Indianapolis & Greenfield and the Indianapolis & Eastern Electric Railway Company have merged by filing articles of consolidation and reincorporation under the latter name, with $1,200,000 capital.

INDIANAPOLIS, IND.—There is a well grounded belief that all the interurban lines entering this city are to be merged. That the Indianapolis lines are to be included is generally disbelieved, but this may be accomplished later on.

COLUMBUS, IND.—A franchise has been granted to J. I. Irwin and W. G. Irwin to extend the Indianapolis, Greenwood & Franklin Railway through the county to Columbus, making a 22-mile extension. The company has purchased a site for a power house.

INDIANAPOLIS, IND.—The Southern Indiana Traction Company has filed articles of incorporation to build a line from Vincennes to Jasper, through Knox, Pike and Dubois Counties. The capital is $100,000. The incorporators are R. M. Gray, Herman Eckert, S. N. Chambers, Sol. Frank and E. F. Cox.

WARSAW, IND.—The Winona, Elkhart & South Bend Electric Railway Company has asked the city council for a 50-year franchise. The project includes the building of a line from Nappanie to Warsaw and Mona Park immediately. The promoters are S. F. George, Dayton, O.; George W. Scott, of Troy, O.; and J. A. Norris, Baltimore, Md.

MARION, IND.—The City Council has declared the Marion Transit Company's franchise, owned by the Union Traction Company, forfeited and instructed the city attorney to bring suit against it in the name of the city for $50,000 damages. This culminated from the action of the Union Traction Company in tearing up 38th Street and putting in a connection at that point without permission.

PARIS, KY.—The Bourbon Fiscal Court has declined to grant a franchise to the Blue Grass Traction Company for a line between Paris and Lexington.

PADUCAH, KY.—The reorganization of the Paducah Street Railway Company has been effected. The company will issue $600,000 in bonds and will make extensive improvements. Officers have been elected as follows: George C. Thomas, president; George C. Wallage, vice-president; A. L. Rich, Cincinnati, secretary-treasurer; H. L. Porter, Cincinnati, superintendent.

NEW ORLEANS, LA.—The New Orleans Railways Company has filed a certificate in New Jersey increasing its capital from five million dollars to forty million dollars. Henry H. Pearson, Jr., is president of the company, which was organized last January.

PORT HURON, MICH.—The directors of the Detriot United Street Railway Company have completed the purchase of the Port Huron Suburban Railway. The price paid was $800,000 and the Port Huron line will be merged with the Detroit United. This inaugurates the entry again into business enterprises of the Everett-Moore syndicate, which controls Detroit United. Having met their obligations to bankers, they will now proceed with the enterprises which were checked by their troubles of last winter.

CAMDEN, N. J.—The People's Traction Company, chartered to build and maintain street railways within the State, has been incorporated here. It is capitalized at $175,000, and among its incorporators is T. R. Sweigart.

NEW YORK CITY.—Efforts have been made by city health authorities to suppress the storage battery cars on West Thirty-fourth Street on the ground that the sulphuric acid fumes from them cause discomfort and are a serious menace to the health of the passengers.

PIQUA, OHIO.—The Dayton & Troy Electric Railway has transferred its general offices from Dayton to Piqua.

LOUDONVILLE, OHIO.—The Mansfield & Wooster Electric Railway has secured a franchise through this town.

STEUBENVILLE, OHIO.—The Steubenville Traction & Light Company has increased its capital stock from $700,000 to $1,000,000.

TOLEDO, OHIO.—The directors of the Toledo & Monroe Railway have decided favorably on the proposition of extending the road to Detroit.

COLUMBUS, OHIO.—The Appleyard syndicate is planning to extend the Columbus, Grove City & Southwestern Railway from Morgan Station to Mt. Sterling and Washington C. H.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg & Columbus Railway Company has secured a 25-year franchise enabling it to reach the center of Columbus. The company agrees to carry city passengers at the rate of 33 tickets for $1.

COLUMBUS, OHIO.—Tucker, Anthony & Co., owners of the Columbus, Buckeye Lake & Newark Traction Company, have taken formal posssesion of the Newark & Granville Railway and the Newark City lines which they recently purchased. A number of improvements will be made to both properties.

NORWALK, OHIO.—The City commissioners have taken matters into their own hands and are removing the rails of the Sandusky, Monroeville, Bellevue & Norwalk Railway from the streets. The company's franchise was declared forfeited a few days ago because of failure to complete the road.

CLEVELAND, OHIO.—Except for the bridge at Birmingham the Norwalk extension of the Cleveland, Elyria & Western Railway is completed. This bridge is one of the largest ever built by an electric railway in Ohio. It has two arches, is nearly 500 feet in length and the track will be 82 feet above the water.

BOWLING GREEN, OHIO.—The promoters of the Lake Erie, Bowling Green & Napoleon Railway have purchased the plant and business of the Citizens' Light, Heat, Power & Ice Company of Bowling Green. The lighting plant is to be enlarged and new engines and generators will be installed to take care of the railway load.

AKRON, OHIO.—The Cleveland, Richfield & Akron Transit Company has purchased a site in Akron to be used for a power house. The company has made a bid for a franchise over the route mapped out by the city commissioners. It looks as if this second line between Cleveland and Akron will be built in the near future. In the meantime the Northern Ohio Traction Company is spending an immense amount of money in double tracking and otherwise placing its road in condition for fast time.

CLEVELAND, OHIO.—The Cincinnati, Dayton & Toledo Traction Company has filed in the several counties traversed by its lines, a trust mortgage for $5,000,000 given to the Cleveland Trust Company to secure an issue of $5,000,000 worth of 5 per cent. 20 year bonds. The mortgage covers all the property recently consolidated to form the company mentioned. A portion of the money derived will be used for the purpose of absorbing other lines to complete the through line from Toledo to Cincinnati.

IRONTON, OHIO.—It is announced that the Camden Interstate Railway Company has sold out to a syndicate headed by John J. Henry and William North, of Philadelphia, and John Graham and Edmund McCandish, of Newville. The property includes the electric railways extending from Huntington, W. Va., to Central City, Creedo, and Kenova, W. Va., Catlettsburg and Ashland, Ky., and Ironton, O. It is reported that these people propose to purchase other lines in the Ohio valley with a view of forming a continuous line from Cincinnati to Pittsburg.

MONTREAL, QUE.—The Montreal Street Railway Company has voluntarily decided to give its employees an increase on the present scale of wages. All men who have been in the employ of the company for two years and over, will get from 15 cents to 16½ cents an hour, and those who have been in its

service under two years will receive from 14½ to 15½ cents per hour. This increase will mean an extra charge upon the company of $50,000 annually.

KNOXVILLE, TENN.—The power plant for the Knoxville-Sevierville Electric Railway will be located on Holston river.

NASHVILLE, TENN.—The city council has finally granted franchises to the Nashville and Gallatin Electric Railway and the Nashville and Columbia Electric Railway.

TATE SPRINGS, TENN.—W. T. Coffee, of Tennessee, will, it is said, build an eighty-mile electric railway from Tate Springs, Hawkins County, Tenn., to Gate City, Va. Hawkins County has voted $100,000 bonds to aid in the undertaking.

PERSONAL.

MR. THEO. T. JACKSON, of Chicago, has been appointed manager of the Evanston Garyan Company, of Evanston, Ill.

PROF. G. F. SEVER, of Columbia University, N. Y., has been making a photometric test of the electric lights at Norwalk and South Norwalk, Conn.

MR. J. C. MOULTON, formerly connected with Stanley & Patterson, of New York City, is now identified with the Fort Wayne Electric Works and is stationed at their New York office.

MR. GEORGE WESTINGHOUSE has received the unusual honor of being elected an honorary fellow of the American Association for the Advancement of Science, which has recently held an annual meeting at Pittsburg.

MR. R. T. LOZIER, who went to Cincinnati recently to take charge of the sales department of the Bullock Electric Manufacturing Company is in New York and the East attending to some important matters for the company.

MR. GEORGE A. NISBET, of the selling forces of the General Incandescent Arc Light Company, has just returned from a very successful Southern trip and last week greeted his many friends at the Electrical Contractors' Convention in Philadelphia.

MR. WILLIAM F. WARDEN, general manager Burt Manufacturing Company, Akron, Ohio, was a visitor to this office last week. He reports large sales for the Cross oil filter with a steadily increasing demand for it. The export trade has grown surprisingly.

MR. A. E. WINCHESTER, the electrical commissioner of South Norwalk, Conn., where he has brought the municipal plant to a high standard of efficiency and success, has resigned as commissioner, but will continue for the present to serve as superintendent of the system.

DR. CARY T. HUTCHINSON requests us to state that an alleged interview with him in the New York Journal, on the Manhattan electric railway system "was false in every particular, and completely misrepresented what I said to the reporter, which was, briefly, that the system was a perfectly safe one."

MR. TOM J. GARDNER, of Las Animas, Col., is now installing an electric light and power plant of about 100-kw capacity in his town. Mr. Clay Belsley, of Peoria, Ill., is consulting engineer, and Mr. W. H. Banes, formerly of Villisca, Ia., is superintending the erection of the plant prior to assuming the management.

MR. WILLIAM H. WARREN, who has for the past two years been connected with the Sprague Electric Company in the capacity of factory electrical engineer, has recently become associated with the Western Electric Company. Mr. Warren will be located at the factory in Chicago, and take charge of the engineering work for all motors. Mr. Warren was formerly with the Westinghouse Company in its draughting department and also with the Bullock Electric Company as chief draughtsman and later as assistant engineer.

MR. LUTHER STIERINGER has been called into consultation to create some original lighting for the new Hudson Theatre near Central Park, N. Y., which is being built by Mr. G. G. Heye. There is much speculation in electrical circles as to what special decorative and stage illumination will be attempted. It is sure to be novel and effective. It is rumored that virtually not a single lamp for direct lighting will be visible anywhere in the house. Stage lighting will also receive attention along new lines. The electrical work is in the hands of Mr. Benjamin Beerwald, of the Pennsylvania Electric Equipment Company, of Philadelphia.

MR. ROBERT I. TODD, second vice-president of the Cincinnati Traction Company, has tendered his resignation to accept a position with the United Gas Improvement Company in Philadelphia, in connection with their traction interests. Mr. Todd is a native of New Jersey, having been born near Lakewood, Nov. 29, 1869. He graduated from the Johns Hopkins University in the class of 1893. His first connection with street railway work was as assistant superintendent of the Eckington and Soldiers Home and Belt Railway Companies, Washington, D. C. Later when these lines and others were merged into the City and Suburban Railway Company, he was made general superintendent and electrical engineer, resigning from this position in the spring of 1899, to take charge of the experimental work of the Compressed Air Company in New York City, on the Metropolitan Street Railway lines. Mr. Todd resigned this position in July, 1900, to accept the position of mechanical engineer of the Consolidated Traction Company of Pittsburg, which position he held until February, 1901, when he accepted the position of general manager of the Cincinnati Traction Company, under the Elkins-Widener-Dolan-Morgan Syndicate. In January, 1902, he was promoted to the position of second vice-president of that company. Mr. Todd's work in these various cities has given him experience with all the latest methods of street car propulsion, horse, storage battery, air, underground electric, single and double trolley, and his wide practice in the traction field has peculiarly well fitted him for the work which he now assumes.

NEW INDUSTRIAL COMPANIES.

WALTER MOTOR & POWER COMPANY has been formed at Pontiac, Mich., under the laws of Delaware, with a capital stock of $1,000,000, to make and sell all kinds of motors.

HUGHES TELEPHONE MANUFACTURING COMPANY has been incorporated at Philadelphia, under the laws of Delaware, with a capital stock of $100,000 to make telephone apparatus.

THE ELBLIGHT COMPANY OF AMERICA, of New York, has been incorporated with a capital of $150,000. Directors; Russell Spaulding, Aulton McMahan, New York; C. W. Bonfils, East Orange.

THE FOX & CALLAHAN ALARM AND ELECTRIC SUPPLY COMPANY, Milwaukee, Wis., capital stock, $50,000, has been incorporated. Benjamin O. Fox, John D. Callahan, Thomas E. Callahan and W. J. Delaney.

THE GENERAL ELECTRIC SIGNAL MANUFACTURING COMPANY, of Newark, N. J., has been incorporated; capital, $50,000. Incorporators: Morris B. Allen, Irvington, N. J.; Edward T. Casebolt, Newark, N. J., and Ernest C. Lum, Chatham, N. J.

BERG AUTOMOBILE COMPANY has been formed under the laws of New Jersey to make automobiles, with a capital stock of $400,000. The incorporators are J. C. Hayes, of Camden, N. J.; and John Wiley and Augustus Treadwell, of New York.

THE KENTON CONSTRUCTION COMPANY, Kenton, Ohio, has been organized for the purpose of engaging in the construction of telephone plants. The capital stock of the company is placed at $10,000. Joseph Timmons, John W. Fulton, J. B. Seymour, James Bastable and F. D. Bain are interested.

AUXILIARY TELEPHONE COMPANY.—The Auxiliary Telephone Company has been incorporated at Newark, N. J., with a capital stock of $100,000, divided into 1,000 shares at $100 each. The concern will manufacture and deal in mechanism for telephone use. The incorporators are Egbert A. Reynolds, of New York, Henry C. Ware, of Orange, N. J.; and C. G. Colyer, of Newark.

GUM CARBO COMPANY.—A charter has been filed in the Secretary of State's office, Austin, Tex., for the Gum Carbo Company, with a capital stock of $10,000,000. The concern will manufacture a substitute for rubber by refining Texas oil combined with cotton seed oil. The incorporators are Robert Bowie, of Chicago, W. F. Enue, of Biloxi, Miss.; R. E. Humphreys, Thomas C. Swope and George C. Waddill, of Beaumont.

STONE TELEGRAPH & TELEPHONE COMPANY.—The Stone Telegraph & Telephone Company, $10,000,000 capital, has filed a certificate at the office of the Secretary of State of Maine. The company was organized at Portland by Alexander Porter Browne and Brainerd Judkins, of Boston; John Stone, of Cambridge, and John W. Anderson, A. G. Berry, M. Warren and William M. Bradley, of Portland. The company will experiment with and develop instruments relating to wireless telegraphy.

LEGAL.

TELEPHONE SWITCHBOARDS.—The Western Electric Company, of Illinois, has brought another suit against the Keystone Telephone Company, of Philadelphia, regarding improvements in multiple switchboard systems.

CLEVELAND FRANCHISES.—Attorney General Sheets began quo warranto proceedings in the Circuit Court at Cleveland to oust the Cleveland City Council, and demanding that members of that body show by what right they hold office. Judge Caldwell of the Circuit Court granted an order restraining the council from granting further franchises or special privileges until the case is heard and decided. Attorney General Sheets holds that inasmuch as the Federal plan of municipal government has been declared unconstitutional by the State Supreme Court, the City Council is an illegal body.

WIRELESS TELEGRAPH SUITS.—It is stated that action has been instituted by the Marconi Wireless Telegraph Company, of America, against the De Forrest system for infringement. Mr. De Forrest asserts that the announcement of the action begun by the Marconi Company was probably premature, as no notice of the suit had been served. Representatives of the Marconi Company, Mr. De Forrest said, had been invited to inspect his equipment. Their experts accepted the invitation and after the inspection he declares, spoke most favorably of the merits of the system. The United States Patent Office has allowed fifty-eight claims to the De Forrest system, and the rights to these patents have been pronounced by legal authorities exceptionally strong. The De Forrest system has offices at No. 17 State Street, No. 13 Battery Park, the Castleton Hotel on Staten Island and at Steeplechase Park, at Coney Island, where the tallest signal mast in the world has been erected. It is reported that the action begun against the De Forrest system is the beginning of a legal battle by the Marconi Company against other companies in this country interested in wireless telegraphy.

Trade Notes.

STANDARD ELECTRIC COMPANY, of Charlotte, N. C., has been incorporated under the laws of Pennsylvania and has changed its name in doing so, becoming the Federal Electric Company.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, reports that it has just received an order from London, Eng., for 28 Cross oil filters and 111 of their exhaust heads. The shipment made one solid carload and constitutes orders placed by its London agency.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY, in a recent trade publication, has departed somewhat from the usual lines of such publications. Instead of a bound catalogue there is a cover, between which are loose sheets illustrating and describing the various styles of telephones manufactured by the company. A separate folder gives an account of "Chicago Pay Stations."

TELEPHONES.—With this title the St. Louis Electrical Supply Company has issued a handsome 32-page catalogue devoted entirely to telephones, telephone switchboards, telephone construction and supplies. Numerous types of telephones are illustrated and also types of small exchange and toll line switchboards. The latter part of the catalogue is devoted to telephone accessories, construction tools and construction materials.

THE JEFFREY MANUFACTURING COMPANY gave its seventeenth annual picnic at Idlewild Park, Newark, Ohio, on Saturday, July 12. Special trains, three in number, took the employees of the company and its other guests from Columbus, Ohio. The day programme included fifteen entries, among which were a ladies' thread and needle race, a girls' egg race, a potato race and the prize awards. In the evening an amateur theatrical entertainment was given.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, report that they are meeting with unusual success in selling their Scheefer Integrating wattmeters for direct and alternating current. This meter embodies a number of new and novel improvements. It is thoroughly dust and bug proof, is very highly sensitive and accurate, and is not affected by alternations or lag. Prices and descriptive matter will be given on application.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agent for Gutmann integrating alternating current wattmeters, announces that it is about to supply these wattmeters with a glass case instead of the regular aluminum case, where ordered. This allows of a close observation of the meter in operation without exposing the parts to dust or dampness. It will be instructive to the managers of lighting plants to have at least one of these.

GENERAL ELECTRIC BULLETINS.—Bulletins Nos. 4,290 and 4,291 of the General Electric Company relate, respectively, to electric railway apparatus and to compensated revolving field alternators. The first-mentioned bulletin is a reprint, with extra illustrations, of a paper read last year by Mr. E. J. Berg at the Buffalo convention of the American Institute of Electrical Engineers. In the other bulletin the details of a compensated revolving field alternator are described and illustrated.

A BOOK OF CURVES.—The Electric Storage Battery Company has made a valuable contribution to the literature of the storage battery in the form of a book giving about two-score curves relating to the operation of storage batteries. The operation of a battery on railway systems is particularly well illustrated by these curves, which exhibit the excellent function which a storage battery performs in taking up load fluctuations and regulating the circuit voltage. Other curves relate to the use of storage batteries on central station systems and also on lighting plants, supplying both lights and motors.

THE KINSMAN ELECTRIC & RAILWAY SUPPLY COMPANY, 91 Liberty Street, New York, has recently entered the supply business with the intention of securing a share of the trade now being offered in the domestic and foreign market. The manager and treasurer, Mr. F. E. Kinsman, has been intimately associated with the electrical and railroad business since 1876. He has made an enviable reputation in connection with the telephone and electric light business, as an originator of the telephone multiple switchboard, and as the person who introduced the arc lamp, both alternating and direct, on the incandescent, or multiple arc circuit, in this country. He can claim a long practical experience as a conservative and successful contractor, supply man and engineer, and is fully qualified to secure the trade and confidence of careful buyers of reliable goods. Within the last few years Mr. Kinsman's experience in steam and electrically operated railroads has been extensive and places him at an advantage with those engaged in that line of business, either as an adviser or supply man. Mr. Samuel A. Wood, the president of the company, is a man of large means and shrewd business acumen, but has heretofore been unknown in the electric business. Mr. W. H. Van Arsdale, the secretary, is a mining engineer of national repute as well as a man of large business experience and means. His acquaintance with electrical matters has been gained through his ownership and management of large smelting and refining plants in Chicago, Aurora, Denver and Leadville, prior to his selling out to the American Smelting & Refining Company. His specialty will be in connection with the copper wire department of the Kinsman Company, which they expect to make a feature of their business. In selecting a New York agent, manufacturers should not overlook the fact that the name Kinsman stands prominent among those of men engaged in electrical enterprises. The new firm wishes to represent manufacturers in New York City and carry a general line of supplies and equipments for steam and electric roads, central stations, etc.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 15, 1902.

(Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.)

704,495. ELECTRIC ARC LAMP; A. M. Arter, Hammersmith, England. App. filed Jan. 12, 1899. The regulating solenoid pulls on a cord which passes over the hub of a pulley and rotates the pulley against a spring; this movement is communicated to the electrodes.

704,496. AUTOMATIC CIRCUIT BREAKER; H. Ballantyne, Sumpter, Oregon. App. filed Aug. 8, 1900. Details.

704,513. DISPLAY DEVICE; S. L. Campbell, Kalamazoo, Mich. App. filed Aug. 22, 1901. A rotating device carrying a number of lamps which are shifted into and out of circuit automatically.

704,525. ELECTRIC ARC LAMP; H. Etheridge, McKeesport, Pa. App. filed Dec. 30, 1901. The carbon rod is provided with notches with which parts of the clutch engage to make the action of the latter positive.

704,543. ELECTRICAL MEASURING INSTRUMENT; E. B. Jacobson, Pittsfield, Mass. App. filed Feb. 11, 1902. An instrument for measuring the voltage and amperage of circuits, comprising a pair of electro-magnets the respective circuits of which are connected at one end to a single terminal and at the other end to an independent terminal.

704,573. DEVICE FOR GENERATING ELECTRICITY ON RUNNING CARS; Richard Pintsch, Berlin, Germany. App. filed Nov. 14, 1901. The transmission of power between the car axle and the generator is effected with the aid of an electromagnetic coupling.

704,575. CENTRIFUGAL COUPLING; Richard Pintsch, Berlin, Germany. App. filed Nov. 14, 1901. The coupling is designed to go into operation only when the driving shaft is rotating slowly, and to become disengaged automatically as soon as the shaft exceeds a certain predetermined speed; it is intended for use in connection with a generator driven by a car axle.

704,589. SPARKING COIL CASING; C. F. Splitdorf, New York, N. Y. App. filed April 30, 1902. A sparking coil casing comprising a shell of tough non-conducting material and an inner lining therefor of material possessing the quality of non-conductivity to a higher degree.

704,595. THERMO-ELECTRIC ELEMENT; C. B. Thwing, Galesburg, Ill. App. filed June 14, 1901.

704,596. THERMO-ELECTRIC GENERATOR; C. B. Thwing, Syracuse, N. Y. App. filed Oct. 21, 1901.

704,597. POWER TRANSMISSION REGULATOR FOR ELECTROMAGNETIC COUPLINGS; Richard Pintsch, Berlin, Germany. App. filed Nov. 14, 1901. Provides means whereby the speed of the driven member may be rendered independent of that of the driving shaft, irrespective of the load on the driven shaft. An auxiliary electromagnetic field opposes a permanent field.

704,616. SAFETY DEVICE FOR MOTOR VEHICLES; H. Charles, Kofa, Arizona Ter. App. filed Feb. 7, 1901. When the seat is occupied the pressure thereon closes the motor circuit.

704,620. SELF-WINDING CLOCK; C. M. Crook, Bristol, Conn. App. filed Sept. 26, 1901. A construction for preventing friction at the contacts from operating as resistance to the running of the train.

704,639. LEACHING AND EXTRACTION OF METALS FROM THEIR ORES; C. Hoepfner, Frankfort-on-the Main, Germany. App. filed Sept. 27, 1899. (See page 132.)

704,649. ELECTRICAL FURNACE FOR TREATING HIGHLY REFRACTORY SUBSTANCES; H. Maxim, Brooklyn, N. Y. App. filed Oct. 30, 1901. (See page 132.)

704,665. CONTROLLING APPARATUS FOR ELECTRIC MOTORS; W. J. Richards, Milwaukee, Wis. App. filed Nov. 16, 1901. An arrangement of various electro-magnetic switches and circuits for automatically starting and stopping an air compressor.

704,670. ELECTRICAL CONNECTOR; A. J. Wayman, Dubois, Pa. App. filed Jan. 16, 1902. Details.

704,671. MOPPING DEVICE; H. F. Ackerman, Cleveland, O. App. filed May 13, 1901. The invention consists of the construction of a reel upon which the conducting cable is coiled and allowed to pay out and be taken up as the movements of the mopping device require.

704,675. PROCESS OF RECOVERING METALLIC TIN; David H. Browne, Cleveland, Ohio, and James M. Neil, Toronto, Canada. App. filed July 27, 1901. A material containing tin is subjected to a solution of ferric chloride, whereby a solution of chloride of tin and ferrous chloride is formed; this solution is then successively carried past a suitable cathode to electro-deposited tin and soluble anode to regenerate the ferric chloride solution, being then returned to the tin bearing material.

704,694. SYSTEM OF DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Sept. 11, 1901. In a system of distribution for railway trains, a generator and current-utilizing devices and a pneumatic device affording delivery of current to the current-utilizing devices always in the same direction, the said pneumatic devices being actuated by a change in the direction of the pressure in a pneumatic system on the train.

704,695. COMBINED ELECTRIC AND GAS CAR LIGHTING SYSTEM; J. L. Creveling, New York, N. Y. App. filed Jan. 18, 1902. A series of train lighting units, each comprising a mutually independent gas and electric lighting system, and a gas engine and dynamo forming a connection between the gas lighting and electric-lighting systems whereby the same are rendered interdependent.

704,696. MEANS FOR REGULATING THE OUTPUT OF DYNAMO ELECTRIC MACHINES; J. L. Creveling, New York, N. Y. App. filed June 12, 1901. A dynamo electric machine combined with means for regulating its output comprised in part by a heat-influenced element in heat receiving relation with the machine.

704,697. TELEPHONE HOOK-SWITCH; Wm. W. Dean, Chicago, Ill. App. filed May 9, 1901. (See page 130.)

704,739. SECONDARY BATTERY; J. B. Entz, Philadelphia, Pa. App. filed Oct. 3, 1900. (See page 133.)

704,744. ELECTRIC ACCUMULATOR; H. Heinicke, Schoeneberg, near Berlin, Germany. App. filed April 28, 1902. (See page 133.)

704,745. GAS BURNER; A. M. Hewett, Chicago, Ill. App. filed Aug. 26, 1901. Details.

704,749. TROLLEY POLE ATTACHMENT; C. P. Lapham, Houghton, N. Y. App. filed Feb. 7, 1902. The journals of the wheel are set in half disks permitting the wheel to swing laterally.

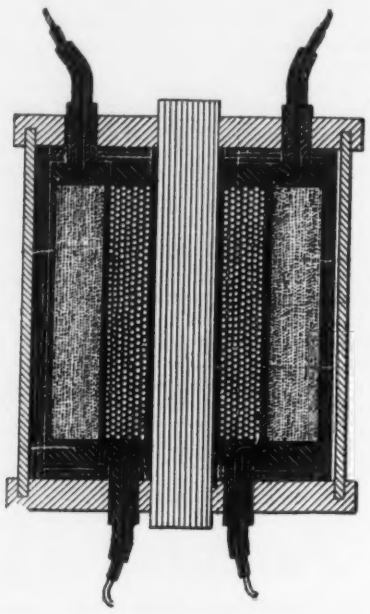
704,759. STORAGE BATTERY SEPARATOR; H. Rodman, Philadelphia, Pa. App. filed July 29, 1901. (See page 133.)

704,751. MANUFACTURE OF SECONDARY BATTERY PLATES OF THE PLANTE TYPE; H. M. Martin, Philadelphia, Pa. App. filed July 30, 1901. (See page 133.)

704,767. SECONDARY BATTERY; E. G. Steinmetz, Philadelphia, Pa. App. filed Sept. 29, 1900. (See page 133.)

704,788. CABLE HANGER; S. Du Perow, Cleveland, Ohio. App. filed May 28, 1902. The suspending hook engages with notches in the strap which embraces the cable.

704,797. RAILWAY HEATER SYSTEM; S. H. Harrington, New York, N. Y. App. filed Jan. 3, 1901. The brake and the switch controlling the



704,589. Coil Casing.

car heaters and so interconnected that the circuit through the heaters is closed only while the brakes are applied.

704,800. SIGNAL; R. Herman, Crafton, Pa. App. filed Oct. 11, 1901. Electrically actuated shifting devices to shift the semaphore to caution and danger positions, controlled by track circuits and a separate circuit controlled by train movements to act as a choke for the signal when tilted.

704,803. ELECTRIC CONTROLLER; A. E. Hogrebe, Philadelphia, Pa. App. filed Dec. 12, 1901. A controller casing having a hinged door or cover upon which the controller cylinder is carried, whereby the latter can be easily inspected.

704,831. PROCESS OF MANUFACTURING SULPHURIC ACID FROM SULPHUR DIOXID IN AQUEOUS SOLUTION BY ELECTROLYSIS; C. B. Jacobs, East Orange, N. J. App. filed June 1, 1901. (See page 132.)

704,851. ELECTRIC LAMP; H. W. Beecher, Jr., Port Townsend, Wash. App. filed Feb. 6, 1902. A multiple filament lamp in which the filaments are successively thrown in and out by altering the distance which the neck of the lamp projects into the circuit.

704,859. ELECTRIC ACCUMULATOR ELECTRODE; V. Cheval and J. Lindeman, Brussels, Belgium. App. filed Nov. 21, 1901. (See page 133.)

704,863. SYSTEM OF ELECTRIC DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Aug. 30, 1900. A centrifugal governor on the armature shaft of a train lighting machine, varies a rheostat to alter the voltage in accordance with the speed.

704,864. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Dec. 7, 1900. The object of the invention is to provide means for automatically preserving a practically uniform flow of current through the lamps of the system and at the same time for protecting the system against waste of energy or other loss under the widely-varying conditions to which the system is, in operation, subjected.

704,865. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Dec. 7, 1900. A regulator in the work-

704,869. Wire Coupling.

circuit of a car lighting system, dependent upon the speed of the armature combined with independent means for nullifying the regulator whenever the generator is ineffective.

704,869. COUPLING FOR WIRES, CONDUCTORS, OR THE LIKE; J. Fischer & H. Schneider, Solothurn, Switzerland. App. filed Jan. 22, 1902. A flexible sleeve of helically wound wire, the coils of which in their free state are spirally shaped, so that when the ends of conductors are inserted into the sleeve, they will be gripped thereby.

704,917. TRANSMITTING APPARATUS FOR ELECTRIC TELEGRAPHS; T. D. Penniman and H. H. Wiegand, Baltimore, Md. App. filed Feb. 18, 1902. In a system in which signals are transmitted by sending a succession of electrical impulses of alternate polarity, a transmitter is adapted to shift the line connection from one set of terminals to another whereby an impulse is sent to line opposite in polarity to that which would have been sent had not the transmitter acted.

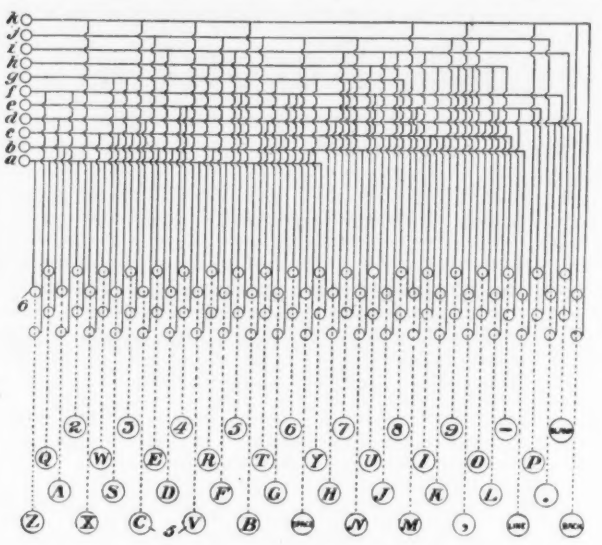
704,925. RECORDER; C. J. Roach, Hartford, Conn. App. filed Oct. 2, 1901. Details.

704,927. KEYBOARD FOR USE IN TELEGRAPHY; H. H. Rowland, Baltimore, Md. App. filed July 24, 1901. A claim describes the invention as follows: In a transmitting keyboard for electric telegraphs, the combination with a group of conductors leading into said keyboard, a series of electrical contacts of greater number than said conductors, permanent electrical connection between said contacts and said conductors by which said contacts and conductors are connected in prearranged combinations, and means for operating circuit through said conductors and sets of said contacts.

704,928. TELEGRAPHIC DISTRIBUTION; H. H. Rowland, Baltimore, Md App. filed July 24, 1901. According to this invention several operators at central may simultaneously transmit messages to all of various substations and simultaneously receive messages from all of them, or several operators at central may send messages to several corresponding substations simultaneously and at the same time record at central the messages transmitted.

704,929. MEANS FOR PRODUCING AND MAINTAINING SYNCHRONOUS MOTION; H. H. Rowland, Baltimore, Md. App. filed July 24, 1901. The invention consists generally in providing means whereby any change of the phase relations between the dynamo or other body to be synchronized and the dynamo or other body with which synchronism is to be maintained results in a change in the amount of energy absorbed by the dynamo or other body to be synchronized and a consequent maintenance of synchronism.

704,930. MEANS FOR IMPRESSING PERIODICALLY-VARYING ELECTRIC CURRENTS UPON TELEGRAPH OR OTHER CIRCUITS; H. H. Rowland, Baltimore, Md. App. filed July 24, 1901. In working a telegraph



704,927. Telegraph Keyboard.

line duplex it is generally necessary to locate at each end of the line a source of signalling current to operate the receiving relay of other main line instrument at the distant end, and when these sources of signaling current are alternating current dynamos this necessitates the employment of a dynamo at each end of the duplex line. The present invention contemplates the employment of means whereby either one or both of these dynamos may be done away with and the signaling current derived from a circuit in which the current is relayed from a source of direct current.

704,948. AUTOMATIC ELECTRICAL SIGNALING APPARATUS FOR RAILWAYS; J. E. Spagnoletti, London, Eng. App. filed May 16, 1902. Details.

704,956. ELECTRIC GENERATOR; W. H. Cotton, Chicago, Ill. App. filed Feb. 5, 1902. The invention comprises a generator and a transformer, the primary coil of which is in connection with the armature, and means located in the connection for cutting out of the circuit the primary coil of the transformer, the parts being so related that the current developed in the armature will be disrupted when the current therein is at maximum, whereby a current of high potential will be induced in the secondary coil of the transformer.

704,974. AUTOMATIC MAGNETIC CIRCUIT BREAKER; W. M. Scott, Philadelphia, Pa. App. filed Feb. 23, 1900. A base, main fixed terminals located thereon, one vertically above the other, the engaging face to one terminal being in a vertical plane, and the engaging face of the othr terminal in a horzontal plane, a laminated bridging member pivoted to the base, an actuating member pivoted to the base, an actuating member and toggle lever connection between said actuating member and the bridging member.

704,975. ARMATURE; F. L. Sessions, Oakpark, Ill. App. filed May 29, 1899. Means for ventilating the armature.

704,986. TELEPHONE BOOTH; F. L. Tufts, New York, N. Y. App. filed Nov. 5, 1901. (See page 130.)

704,987. TELEPHONE BOOTH; F. L. Tufts, New York, N. Y. App. filed Dec. 24, 1901. (See page 130.)

704,993. ELECTRIC SMELTING FURNACE; F. C. Weber, Chicago, Ill. App. filed Jan. 8, 1900. Renewed May 16, 1902. (See page 132.)